THE EFFECTS OF MANUAL SIGNS, SPEECH, AND SIMULTANEOUS COMMUNICATION ON COMPREHENSION OF LABELS BY AUTISTIC CHILDREN

BY

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THE EFFECTS OF MANUAL SIGNS, SPEECH, AND SIMULTANEOUS COMMUNICATION ON COMPREHENSION OF LABELS BY AUTISTIC CHILDREN

By

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Chairman: Dr. Robert Algozzine
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Presently training programs for autistic children often utilize manual signs. Research has established that training consisting of manual signs and verbalizations presented simultaneously is effective for teaching some autistic children to understand and produce a limited number of manual signs.

Because manual signs typically are combined with verbalizations during training, it is not clear whether claims made for simultaneous communication are, in fact, the product of the combined input of speech and manual signs or simply the product of either of the components separately (verbalizations only or manual signs only).

This study was designed to investigate those components of simultaneous communication (the manual signs and the verbalizations) which enhance receptive language in autistic children. The extent to which manual signs, verbalizations, and simultaneous communication facilitate comprehension was studied.

A single-subject experimental design was used to facilitate an in-depth analysis of specific responses of selected autistic children to simultaneous communication and the relationship between their responses and learning behavior. A multiple schedule design was used within an overall ABABA design.

Three moderately to severely autistic children, ages 7-14, were selected for experimental subjects. One subject was nonverbal, one unintelligible, and the third verbal but exhibiting severely delayed language. Fifteen-minute experimental sessions were conducted daily with each of the subjects individually.

The subjects were taught, using simultaneous communication, to point to a labeled object. After the subject reached criterion level of performance probe conditions were initiated to determine whether the separate components of simultaneous communication could produce the same level of comprehension as the combination of the components. The results of this section of the study were compared to the results of the second section in which teaching with manual signs only, teaching with speech only and teaching with simultaneous communication were compared.

This study suggests that autistic children may be able to learn when simultaneous communication is used as a teaching technique. Although each of the subjects responded with a high degree of accuracy to simultaneous communication stimuli, it became apparent that each of the three subjects were attending to different aspects of the stimuli presented in simultaneous communication. When taught using simultaneous communication one subject attended only to the manual sign component, one attended only to the verbal component and the third attended to both but consistently selected the verbal component when compelled to choose.

Further analysis showed that the addition of manual signs to the teaching situation did not inhibit or enhance learning by the two subjects who attended to the verbal component of simultaneous communication. However, withdrawal of the verbal stimuli severely impaired learning. Similar findings were evident for the subject who attended only to the manual signs. The addition of verbal stimuli to the manual signs did not enhance or impair learning; learning was hampered only when manual sign cues were not available.

The findings of this study are supported by the literature on stimulus overselectivity in autistic children. The literature indicates that autistic children have a tendency for selection of one stimulus from numerous available stimuli and that the preferred stimulus is consistent for the individual child but variable among children.

The results of the present study suggest that thorough educational assessments of autistic children should include a procedure for determining the input modality that is most effective and least effective for facilitation of communication and learning. The methodology used in this study demonstrated that systematic manipulation of identified components of simultaneous communication was an effective procedure; the preferred stimulus component was identified easily for each subject and the role of the components during a learning task was evident.

CHAPTER I
INTRODUCTION

Delayed language and difficulty establishing functional communication skills are identified consistently as characteristic of many handicapped children. Moreover, the development of communication skills is regarded as important and essential for the continued growth and development of these children. Researchers have emphasized the extreme importance of communication training especially for autistic children (Lovaas, Berberich, Perloff, & Schaeffer, 1966; Rimland, 1964; Ritvo, 1976; Rutter, 1968). The significance of a communication deficit is highlighted by the finding that those autistic individuals who develop some communication skills have a better prognosis than those who do not (Ritvo, 1976; Rutter, 1968). Consequently, therapeutic and educational programs are designed principally to facilitate communication and develop language functioning.

Treatment programs for autistic children have utilized different strategies including operant conditioning techniques (Lovaas et al., 1966; Wolf, Risley, & Mees, 1964), medication (Campbell, 1978; Rimland, 1971), and psychotherapy (Berlin, 1978; Deslauries, 1978). Presently, manual signing also is used in communication training for autistic children

(Fristoe & Lloyd, 1978; Goodman, Wilson, & Bornstein, 1978). Programs which teach manual signs typically use simultaneous communication techniques, an approach in which verbalizations and manual signs are produced at the same time (Fristoe & Lloyd, 1978).

Both verbal stimulation and manual signing have been accepted as important factors for the development of communication. Verbal stimulation, as well as other auditory stimuli, is extremely valuable and important for communication learning in normal children (Bloom & Lahey, 1978; Schiefelbusch, 1972). Similarly, manual signs are important stimuli for communication development in deaf children; because many deaf children have some residual hearing, manual signs often are accompanied by verbalizations (Liben, 1978).

There is some research, however, concerning the effect of auditory stimuli on learning in autistic children, which suggests that autistic children function better on tasks that primarily require visual integration rather than auditory integration (Davis, 1970). This finding, and the belief that gestures and facial expression are crucial in communication with many autistic children (Fant, 1964; Jakab, 1972; Pronovost, Wakstein, & Wakstein, 1966; Ruttenberg & Gordon, 1967) have led researchers to speculate that manual signs may provide an input medium which can result in the development of communication skills. Therefore, manual signs have been incorporated into many programs for autistic children. This results in a multisensory input approach with two major components: verbalizations and manual signs (Fristoe & Lloyd, 1978; Goodman et al., 1978).

Because of reports of preferences by autistic children for visual rather than auditory stimuli (Davis, 1970), the question of the role of verbalizations during manual sign training for autistic children arises. This question is highlighted by the result of research concerning the autistic child's response to multisensory stimulation. This research suggests that autistic children tend to select and attend to only one stimulus and exclude all other simultaneously presented stimuli (Kolko, Anderson, & Campbell, 1980; Lovaas, Schreibman, Koegel, & Behm, 1971).

There has been little research which systematically examines the response of autistic children to simultaneous communication training. Articles in which researchers strive to define the effects of a program which incorporates manual signs abound. Most investigators simply describe the autistic child's production of manual signs; several address skill in comprehension of signs.

Although such reports provide valuable information, it is clear that a thorough discussion of the efficacy of simultaneous communication training or manual communication training for autistic children must be based on an understanding of the effects of each of these components (verbalizations and manual signs) separately as well as the effects of the whole (simultaneous communication, i.e., manual signs together with verbalizations) on learning by autistic children.

The Problem

Throughout the years professionals have been searching for an effective means of crossing the communication barrier that exists between them and autistic children. However, the various methods tried thus far have yielded limited results with the current approach, simultaneous communication, being relatively uninvestigated. Therefore, the question arises regarding its effectiveness as a tool for communication with autistic children. Investigations concerning the autistic child's response to teaching which uses simultaneous communication compared to other approaches clearly are indicated.

Rationale for Importance

Published reports have established that training consisting of manual signs and verbalizations presented simultaneously is effective in teaching some autistic children to understand and produce a limited number of manual signs (Benaroya, Wesley, Ogilvie, Klein, & Meaney, 1977; Bonvillian

& Nelson, 1976; Fulwiler & Fouts, 1976; Miller & Miller, 1973). Because the manual signs typically are combined with verbalizations during training, it is not clear whether the claims made for simultaneous communication are, in fact, the product of the combined input of speech and signs or are simply the product of either of the components separately (verbalizations only or just the manual signs). To date, there has been one investigation of the effects of teaching autistic children with manual signs only versus verbalizations only compared to teaching using simultaneous communication (Barrera, Lobato-Barrera, & Sulzer-Azaroff, 1980). This study investigated the effects on development of expressive language skills. Clearly such studies are needed to formulate both a teaching and a research base which use manual signs for the development of communication in autistic children. However, it is not only important to learn which methods enhance expression by autistic children. It is also crucial for effective teaching to discover which methods enhance reception of language input since both communication and learning are based on expression and comprehension (Bloom & Lahey, 1978). Research in these areas will further the search for the most effective training technique for autistic children.

Purpose

This study was designed to investigate those components of simultaneous communication (manual signs, verbalizations, manual signs and verbalizations together) which enhance receptive language in autistic children. The extent to which manual signs, verbalizations, and simultaneous communication facilitated comprehension was studied. Thus, the question investigated was: Which of the stimuli of simultaneous communication (_1_ the manual signs, _2_ the verbalizations, or _3_ the combination of the manual signs and the verbalizations) facilitates comprehension of object labels by autistic children?

Assumptions

The following assumptions are made in this study:

1. The children participating in this study are autistic. Many different criteria could be used to select children for the label of "autistic" since the precise nature of and an objective test for autism is not known. Therefore, the children in the program for autistic children who were labeled autistic by an interdisciplinary team and a child psychiatrist will be assumed to be autistic.
2. Autistic children can be trained to respond to simultaneous communication. Numerous studies (see the review of the literature) report that children labeled autistic can be taught a limited number of manual signs, both receptive and expressive.

3. A pointing response represents comprehension. This is a standard method in language training procedures and research studies for indication of comprehension.
4. Those children passing the hearing screening test are different from those who fail the hearing screening test only in terms of hearing acuity. Autistic children sometimes ignore auditory stimuli even though they have an intact auditory mechanism (Ritvo, 1976). Because only children with adequate hearing acuity should participate in this study (due to the dependence on hearing to complete the required tasks) it is necessary to assume that accurate hearing screening is possible.

Delimitations

Several factors are recognized delimitors in this study. Research was conducted in a county public school system, which is located in the southeastern United States. Additionally, all of the subjects were autistic children who resided at home with their natural parents. The use of a small room adjacent to the classroom as the experimental setting represented an additional delimitation.

Limitations

The use of nonsense signs, words and objects restricts the scope of this study as does the limited number of children available for study and the heterogeneous character of the autistic population.

Definition of Terms

The following key terms appear throughout this study and are applied according to these definitions.

Autistic children are those children enrolled in classes for autistic children, diagnosed as autistic by an interdisciplinary team which includes a child psychiatrist, and demonstrating the following characteristics which have been identified as typical of autism by the National Society for Autistic Children: avoidance of eye contact, abnormal use of objects, maintenance of sameness, increased level of activity and stereotypic behaviors, absence of attempts at communication, abnormal interpersonal relationships.

Nonsense words are words that cannot be identified as a word in the English language but which comply with the linguistic rules of the English language.

Nonsense objects are objects for which there is no known English label.

Nonsense signs are movements of the hands which cannot be identified as an existing manual sign in American Sign Language.

Verbalizations are the audible portions of spoken utterances.

Manual communication is communication accomplished by movement of the hands in space relative to the body.

Manual signs are the movements of the hands in space relative to the body for the purpose of communication.

Simultaneous communication is communication in which manual signs are accompanied by vocalized speech.

Summary

Autistic children have severe deficits in communication. Currently, training programs are using manual signs combined with speech to facilitate communication development. This approach results in the presentation of several stimuli simultaneously. Research has established that autistic children can learn a limited amount using this training method; however it is not clear which of the simultaneously presented stimuli is the facilitative factor. The present study is designed to investigate this problem: the effect of speech only, manual signs only, and a combination of speech with manual signs on comprehension by autistic children.

CHAPTER II
REVIEW OF THE LITERATURE

Autistic children have severe communication deficits. Currently, manual sign language is used in communication training for autistic children (Fristoe & Lloyd, 1978; Goodman et al., 1978). The following review of the literature will critically examine the nature and extent of the literature upon which this practice is sustained. An exhaustive review of the literature on the use of manual signs with autistic children was conducted.

Selection of the Relevant Literature

The literature included in this review was located by several methods. The comprehensive review of the literature included two computer literature searches, the Medline search and the ERIC search, both using autism, sign language, manual signs, and simultaneous communication as key words. Further, the Current Index of Journals in Education and Psychological Abstracts were examined for the years 1969 to January 1981 using the same descriptors. A search of Dissertation Abstracts from 1978 through 1980 also was included.

After securing the articles identified through the above described means, the bibliography of each of the articles located was examined to identify additional relevant papers. Finally, a list of all of the journals represented by the identified articles was prepared. The index for each year from 1969 through 1980 for all of these journals was examined.

Several guidelines were established to assist in selection of the articles for review. First, manual signs must have been used to train at least one subject described as autistic or autistic-like. Second, data collected to describe the subject's performance must have been reported in the article.

Nature of the Literature

A comprehensive review of the literature revealed only twelve articles which described the use of manual communication with autistic children and met the stated criteria; two were published in 1973 and the remaining within the last five years. A brief description of the nature of each article is presented in Table 1 which shows that research in this area is characterized by descriptive studies involving small numbers of subjects with single-subject designs characterizing the research of the past two years. The use of manual communication with the autistic population has been limited to one age category, children ages four through 15 years with the exception of Miller and Miller (1973) who reported subjects with ages ranging from five to 23 years. Further, Table 1 shows that researchers primarily have

Table 1. Description of the twelve studies included in the present analysis of the literature on manual signing and autism.

			Signs Studied	
Investigator	Subject	Type of Study	Receptive	Expressive
Miller & Miller (1973)	19 children 5-23 years	Descriptive	X	X
Webster et al. (1973)	5 1/2-year-old male	Descriptive	X	
Bonvillian & Nelson (1976)	9-year-old male	Descriptive		X
Fulwiler & Fouts (1976)	5-year-old male	Descriptive		X
Benaroya et al. (1977)	6 children 5-12 years	Descriptive		X
Konstantareas et al. (1977)	5 children 5-9 years	Descriptive	X	X
Salvin et al. (1977)	5-year-old male	Descriptive		X
Casey (1978)	4 children 6-7 years	Single-Subject		X
Carr et al. (1978)	4 children 10-15 years	Single-Subject		X
Brady & Smouse (1978)	6-year-old male	Single-Subject	X	

Konstantareas et al. (1979)	4 children 8-10 years	Descriptive	X	X
Barrera et al. (1980)	4 1/2-year-old male	Single-Subject	X	

investigated the production of manual signs by autistic children rather than receptive skills in this area.

Reports describing programs which teach manual signs to autistic children conclude that the children are able to learn to produce manual signs. Acquisition of words, improvements in behaviors, and production of multi-sign combinations are reported also (Table 2). Critical examination of the studies reveals that acquisition of skill in manual signing is determined by one of two methods: 1) counting and/or graphing performance over time or 2) measuring and reporting post-treatment performance with the absence of comparison data.

The research using the single-subject designs is comprised of data suggesting that simultaneous communication is an effective teaching technique; comprehension of commands, acquisition of words and signs, and improved behavior are reported (Table 2). Counting and graphing performance over time, comparison of baselines, and statistical analyses were methods used to determine success with manual signs.

The identified literature on manual signing and autism will be discussed and reviewed according to the following topics relevant to the present study: 1) production of manual signs by autistic children, 2) comprehension of manual signs by autistic children, 3) comparison of manual signs to other teaching methods, and 4) effects of stimulus components of simultaneous communication.

Table 2. Results of programs which taught autistic children using manual signs.

Investigator	Single Signs Learned	Combinations of Signs Learned	Non-Language Benefits
Miller & Miller (1973)	Claimed	Claimed	Claimed
Webster et al. (1973)	Claimed		Claimed
Bonvillian & Nelson (1976)	Claimed	Claimed	Claimed
Fulwiler & Fouts (1976)	Claimed	Claimed	Claimed
Benaroya et al. (1977)	Claimed	Claimed	Claimed
Konstantareas et al. (1977)	Claimed	Claimed	Claimed
Salvin et al. (1977)	Claimed	Claimed	
Casey (1978)	Claimed		Claimed
Carr (1978)	Claimed		
Konstantareas et al. (1979)	Claimed	Claimed	Claimed

Production of Manual Signs by Autistic Children

In general, the use of manual signs with autistic children has focused on the expressive use of signs. Both individual autistic children and small groups of children have been taught to produce manual signs. Typically, signs were taught simultaneously with spoken words. Table 2 shows that reports in the literature suggest that autistic children are able to learn to produce a limited number of manual signs as a result of training. Close analysis of this literature indicates that the early reports contain problems with observational and definitional criteria. Furthermore, as Table 3 clearly illustrates, the subject population in these studies generally was defined poorly.

The literature on the production of manual signs by autistic children will be reviewed first by analyzing reports of the performance of individual cases followed by a review of reports which base findings on the performance of a group of children.

Individual Cases

Bonvillian and Nelson (1976) reported that a nine-year-old mute, autistic boy learned to produce many spontaneous signs and combinations of signs using American Sign Language. The child acquired 56 signs during the six-month training period which involved formal sessions and informal use of signs in the home; however it was not clear whether

Table 3. An analysis of the descriptions of the subject populations of the studies on manual signing and autistic children.

Investigator	Detailed History	IQ Reported	Prior Therapy	Described Speech Characteristics
Miller & Miller (1973)	Some Subjects			Some Subjects
Webster et al. (1973)	Brief			
Bonvillian & Nelson (1976)	X	X	X	
Fulwiler & Fouts (1976)			X	
Benaroya et al. (1977)	No case information			
Konstantareas et al. (1977)				X
Salvin (1977)	X	X	X	X
Casey (1978)	Brief			Brief
Carr (1978)	Brief		X	X
Brady & Smouse (1978)	X		X	X
Konstantareas et al. (1979)				Brief
Barrera et al. (1980)	X		X	X

Hearing Tested	Behavioral Measures	Severity Measures	Initial Gesturing Reported
		X	
X			X
			X
	X		
			X
	X		X
X			
	X		

acquisition was considered receptive, expressive, or imitative use of a sign. Spontaneous use of signs was determined by observations of the parents, teachers, and observers; interrater agreement was not measured. This procedure for evaluation of the performance of the child compromises the findings of the report since the persons evaluating the child's use of signs obviously were biased and agreement among their observations was not obtained.

In a similar project involving a five-year-old mute, autistic boy, signing was limited to formal training sessions and the child acquired 26 "signed expressive words" (Fulwiler & Fouts, 1976). Again, it is not clear whether these productions of signs were spontaneous, elicited, or imitative in nature. Although the child reportedly acquired vocal words as a result of the simultaneous sign and speech training program, baseline measurements were not available to confirm that this behavior was a direct result of the training program. Further, methods and criteria for making the observations to describe the performance of the child as a result of the training program were not presented in the article.

Salvin, Routh, Foster, and Lovejoy (1977) also reported that a mute, five-year-old, autistic boy learned to produce manual signs as a result of training which included manual signs and simultaneous speech during structured sessions throughout the day in the classroom and at home. The child mastered 12 signs and used the signs spontaneously. In this study, however, independent observers, trained to 87 percent agreement with the experimenter, recorded signing behavior during formal sessions to determine mastery of a sign and during three specific 48-hour periods for measurement of spontaneous use of signs.

Additionally, the _Alpern-Boll Communication Scale_ was adapted to address signs rather than vocal words and was used as a pre-test and a post-test of communicative skill. This measure suggested that the child made six months' growth in communication during the three-month period. While the authors clearly demonstrated that the child learned and used 12 different signs as a direct result of the program, it is not possible to attribute the growth in communication evidenced by the _Alpern-Boll Communication Scale_ to this program; a simultaneous language program in the child's classroom and therapy program may have produced this apparent gain.

Small Groups of Children

Miller and Miller (1973) conducted a language training program which combined manual signs and speech. They reported the total number of _signs paired with words_ that were comprehended and produced by the 19 children in their program as well as the total number of _words_ comprehended and produced by the children. However, the significance of these data is diminished by the obvious lack of pre-treatment assessment along these same dimensions; no measure of vocabulary comprehension or expression were obtained. Thus, it is questionable whether the achievement of signs and spoken words reported by Miller and Miller (1973) were a function of the treatment program.

Similarly, Benaroya et al. (1977) reported the acquisition of signs and words as a result of a multi-sensory input program using a Language Master, audiotapes, sensory integration exercises, and sign language training. They periodically assessed the children using the *Peabody Picture Vocabulary Test*, the *Columbia Mental Maturity Scale*, and behavioral ratings, however only the final signing and verbal vocabularies were reported making it difficult to acertain communication growth as a direct product of the treatment program. Further, it would be useful to know which of the components of the multi-sensory program were necessary to produce acquisition of the manual signs that was reported; however, this factor was not considered.

Konstantareas, Oxman, and Webster (1977) taught a group of five children manual signs using simultaneous speech and manual signs during a six-week program. At intervals throughout the day the staff members recorded the performance of the children as receptive, reproductive, or spontaneous communication; interrater agreement measured at the end of the program indicated that agreement for spontaneous use of signs ranged from .56 to 1.00. At the end of each day each therapist who worked with the children rated each child on a 31-item behavioral checklist. A video tape segment of the second and the fifth weeks was judged by the experimenters and an independent rater.

The children in this study displayed significantly improved behavior according to the daily behavioral ratings and also acquired some skill with manual signs evidenced by the video tapes and the daily descriptions of the children's communicative behavior by the trainers. The total number of signs for each subject was presented graphically; however, it was not clear whether the total number referred to the cumulative number of different signs produced by each child or simply the cumulative number of signs produced.

A very wide range of responses to this program was noted; one child acquired 52 spontaneous signs, 90 receptive signs, and 121 reproductive signs while another child did not acquire any spontaneous signs and acquired only one receptive sign and 21 reproductive signs. The child who acquired the largest repertoire of signs was also the same child for whom the lowest interrater agreement was found for spontaneous signs (.56). The lack of consistent interrater agreement and the possibility of observer bias during recording of communicative behaviors compromises the reported findings of this study.

In 1979, Konstantareas, Webster, and Oxman published a report of their program outlined in the 1977 article after completing training with five children over a nine-month period. The names and descriptions of two of the subjects corresponded to that presented in their earlier paper; however, it is not clear whether the data in their 1979, report were gathered after that reported in their first account of their training program, or whether the data presented in this later report included that obtained earlier.

Because two of the subjects reported in the 1979, paper were not presented in the earlier account, their performance reported in the later article must have been subsequent to the initial six-week study. The data for one subject (Larry) appeared, at the six-week interval, to be the same data reported in the earlier 1977, paper. However, the data of the second subject, Stewart, indicated a considerably poorer performance at the six-week interval in the later paper compared to the data presented earlier suggesting the two reports, 1977, and 1979, represented different situations for this subject.

The inconsistency in the data severely compromises the results of this 1979, report. The data were grouped to statistically analyze the differences between pre-treatment and post-treatment behavior along several dimensions: language development, social interaction, and behavior. However, since it is unclear whether or not all of the subjects received treatment at the same point in time, the possibility that performances of the subjects may have been affected by differing extraneous circumstances exists. While the authors show that their autistic children can learn to produce some manual signs, they did not clearly demonstrate that such learning was a direct function of their training program.

Carr et al. (1978), recognizing the lack of well-controlled research to substantiate that autistic children can learn to use manual signs for meaningful expression, taught five manual signs, in a multiple-baseline across signs study, to four subjects and replicated the results.

Training sessions were conducted three or four days each week for one hour. During this time, production of the manual signs was trained according to a specified procedure. When criterion level of performance was obtained an additional manual sign was introduced until each subject could produce all five manual signs.

The results of this study clearly demonstrate that autistic children can learn to use a limited number of manual signs when taught using simultaneous speech and manual signs. The results were reliable, replicable across subjects, and also generalizable across trainers.

Comprehension of Manual Signs by Autistic Children

Several investigators have reported that autistic children can learn to comprehend manual signs. Miller and Miller (1973) incorporated 50 manual signs in their training program for 19 autistic children. Commands were given to the children using simultaneous manual signs and verbalizations. Miller and Miller (1973) reported that each child learned to comprehend some of the manual signs; the number of signs paired with words that the subjects learned ranged from six to 50. Because the number of spoken words that each subject learned receptively was very similar to the number of signs paired with words that were learned receptively (with the exception of one subject), it cannot be assumed that the subjects had, in fact, learned to comprehend the manual signs. Their comprehension may have been based on the verbal cue given when the manual sign was presented.

Konstantareas et al. (1977; 1979) also reported the number of manual signs the children in their training program learned to understand. Assessment of comprehension was conducted informally by teachers, parents, and observers with interrater agreement ranging between 75 to 100%. Although Konstantareas et al. (1977; 1979) did not demonstrate that comprehension of manual signs was a direct result of their intervention, they did show that autistic children can learn to comprehend the meaning of some manual signs.

Webster, McPherson, Sloman, Evans, and Kuchar (1973) also incorporated manual signs into their training programs. A six-year-old boy was taught to follow commands which were given orally only, with manual signs only, and with a combination of verbal and manual sign cues. The results showed that the child was able to follow commands with 80% accuracy when only manual signs were used. Although an independent observer recorded responses, the sessions were not controlled experimental sessions; the data represent the documented performance of a child during nine instructional sessions.

Brady and Smouse (1978) used a comprehension task to compare three methods for language training. A series of 27 commands were adminstered to a single six-year-old boy using a simultaneous-treatment design. The results indicated that the autistic child could learn to comprehend manual signs; however, comprehension was improved when speech accompanied the manual signs.

Although methodological problems in studies on comprehension and manual signing make it difficult to attribute learning to the described program, it is still clear that autistic children can comprehend some manual signs.

Effects of Manual Signs on Oral Language and Behavior

Two investigators have studied the effects of manual signs on aspects of behavior other than expression or comprehension.

Alarcon (1978) investigated the effects of simultaneous communication on the development of oral language. Three autistic children were taught 20 vocabulary words during 20-minute sessions four days each week over a five-month period. Simultaneous communication was used. Speech only was used in training sessions for three control subjects.

The results of this study indicated that simultaneous communication improved oral language development but was not a functional alternative communication system when used in a classroom setting.

Casey (1979) also conducted a program with a small group of autistic children to study the impact of manual signs. The effect of manual sign training on behavior and communication was investigated. Parents were formally taught Signed English to use with their children during formal daily sessions in the clinic and informally at home when appropriate. Teachers also used Signed English throughout the day in the classroom. Two observers recorded communicative behavior and inappropriate behavior according to specified criteria during the formal parent-child session and in the classroom. The manual sign treatment (mothers using signs with the children in formal sessions in the clinic) was added successively by weeks to the children's programs after two weeks of baseline observations in a multiple-baseline across-subjects design. The observations indicated that communicative behavior increased and inappropriate behavior decreased during the mother-child sessions and in the classroom as a result of the treatment condition. Although a high degree of reliability was obtained between the observers, the chance of observer bias is still present since the observers were not blind as to when treatment conditions were initiated for each child.

Comparison of Training Methods to the Use of Manual Signs

Two studies have been conducted recently to compare language training programs which use manual signs to programs which use simultaneous communication or verbal stimuli only.

Barrera et al. (1980), in a single-subject, multi-element design, compared the effectiveness of three treatment programs for development of expressive language. Vocabulary was taught, using speech only, signs only, and simultaneous communication, to a 4-year-old boy during 20-minute training sessions. Statistical analysis of the data showed that training which combined manual signs and speech resulted in the highest percentage of correct responses. The results were replicated and generalizable across trainers.

Although Barrera et al. (1980) conducted a well-designed study, the significance of their findings is decreased by the lack of clarity concerning the behavior that constituted a correct response. A trained observer recorded all gestural and vocal responses of the child after each trial. These data were subsequently grouped for the statistical treatment. Hence, verbal labeling of a stimulus picture or object would constitute a correct response regardless of the training method under study, manual signs only, speech only, or simultaneous communication.

In a similar study, Brady and Smouse (1978) compared the same three teaching methods; however, they conducted the investigation using a comprehension task instead of a language expression task. The child was taught a series of 27 commands. Seven 30-minute sessions were conducted for each of three teaching methods; the procedure was repeated with three separate experimenters. The results were grouped and the statistical analysis suggested that simultaneous communication resulted in greater comprehension of the commands.

The three treatment methods were adminstered in random order and counterbalanced across the three experimenters. The same series of 27 commands was used throughout the entire study.

Thus, during training which used verbalizations only, the child was taught to respond to the verbal label and rewarded for correct responses and similarly so during training with manual signs. Therefore, when the same commands were given using both the verbal cue and the manual sign cue, the number of correct responses would be expected to increase showing a summative effect. Any command for which the verbal cue may have been forgotten may be recalled by the manual sign cue and any command for which the manual sign cue may have been forgotten may be recalled by the verbal cue. As expected, the performance of the subject in response to simultaneous communication cues steadily improved. This apparent superiority of simultaneous communication training is misleading since it may represent learning that occurred during training with the other two teaching methods, manual signs only or speech only.

Effects of Stimulus Components of Simultaneous Communication

Although not the primary focus of their research, several investigators conducted studies which contained a component that examined the impact of individual stimuli on responses to simultaneous sign and speech programs. Webster et al. (1973), for example, trained a six-year-old, mute, autistic, retarded boy to follow gestural commands which were taught using simultaneous signs and speech after attempts with verbal commands were unsuccessful. Performance of commands was tested by using signs only, by speaking only, using signs and speech together, and using an inappropriate association of signs and speech. An independent observer recorded correct responses. The child responded best (80 percent correct) when commands were given by sign alone and worst when commands were given vocally alone (44 percent correct). Only one observer collected data and clear criteria for classification of responses and methods for observation were not included. Thus, the results may not be reliable; there is a possibility of observer bias and random categorization of responses.

Konstantareas et al. (1979) investigated the response of four autistic children to a program that used simultaneous signs and speech. In addition to analyzing the effects of the program on intelligence, social interaction, and behavior they analyzed improvements in communication and included a study of the cues that affected responses. Throughout the day teachers informally instructed the children using signs and speech simultaneously in a four-step sequence to teach the signs. Each day the teacher periodically recorded the child's communicative performance in terms of four categories, reproductive (imitative), elicited (cued), receptive, and spontaneous and listed the signs to which the child was exposed. It is not clear whether the children had the same trainer or different trainers, whether instruction was group or individual.

Communicative measures obtained during formal testing sessions one month before the program terminated involved all of the signs to which the child had been exposed. No criterion level of performance was required before teaching was initiated on additional signs or before teaching responses to each of the separate components of simultaneous communication. To investigate the effects of each of the component stimuli on comprehension of manual signs, the examiner presented signs by sign only, by sign and speech together, and vocally only. Children were required to imitate signs, speech, and signs and speech together to determine the preferred stimulus of reproductive responses. Investigation of the preferred stimulus component for elicited responses was investigated similarly. The results suggested that control for receptive responses is not influenced by the three conditions (sign, verbal, sign and verbal together); responses were the same in all conditions. However, the sign only condition appeared to be preferred for reproductive and elicited responses.

Several methodological problems are evident in this study. First, in their previous study (Konstantareas et al., 1977) the authors noted that the interrater agreement was poorest for classification of spontaneous use of signs. However, the present study which involves the same procedure for classification of signs does not measure interrater agreement and does not describe safeguards to assure accurate and uniform recording of data. Second, the testing procedure and criteria used to assess responses to determine the preferred modality for the responses are not described fully. Thus, although the total number of signs and signs plus words obtained during the final testing are presented in detail, the impact is decreased since it is not clear how the data were obtained.

Carr et al. (1978) not only investigated the efficacy of simultaneous communication training for four nonverbal, autistic children but they also studied the specific stimuli that may control signing behavior. Five signs were taught using simultaneous signs and words and objects. A multiple-baseline across objects (signs) design was used. The results, which were reliable, replicable across subjects, and generalizable across therapists, indicated that autistic children can learn to produce manual signs. Interobserver reliability for evaluation of the children's responses was high.

To investigate which stimulus of several simultaneously presented stimuli were needed for the production of the manual signs, the children were tested in three conditions, visual, vocal, and lipreading. Signing behavior was recorded when the experimenter displayed the objects to be labeled to the child, second, when the experimenter spoke the name of the object (with lip movement concealed), and third when the experimenter mouthed the name of the object to be labeled. The results indicated that the production of manual signs that are taught with the simultaneous method is controlled by the visual cue associated with an object and is independent of auditory cues related to the same object.

Carr et al. (1978) investigated the stimulus needed for production of manual signs and found that while simultaneous signs, speech, and objects can be used to teach a child to sign, the overt signing behavior is controlled by the vision of the object. There is no controlled experimentation investigating the stimuli presented during the simultaneous method which are needed for comprehension of the labels that are taught. Clearly, objects are necessary to produce the signs that are learned, however, it is not clear what stimuli are needed to acquire the initial comprehension of the object label.

Summary

Research on the use of manual communication with the autistic population consists largely of uncontrolled experimentation. The reports of programs teaching signing indicate that autistic children are capable of learning to produce a limited number of signs. Articles were reviewed which show that individual children as well as small groups of children have been taught to produce some manual signs. Several articles were reviewed which investigated the stimuli which are needed to produce signing behavior. One controlled study in this area was located and reviewed. The results suggest that overt signing is controlled by a visual stimulus of a given object. Although there are two studies which discuss the component stimuli of simultaneous communication operative for comprehension of signs, this area remains uninvestigated due to a lack of well-controlled experimentation.

CHAPTER III
METHODS AND PROCEDURES

Many programs for autistic children currently include some manual signs in their educational and/or therapeutic programs. Reports of such efforts indicate that simultaneous communication improves communication with autistic children. Because manual signs typically are combined with verbalizations during training, it is not clear whether the reported success of simultaneous communication training is, in fact, the result of the combined input of speech and manual signs or simply the product of either of the components separately. This study was organized to investigate the effects of the components of simultaneous communication (manual signs, verbalizations, manual signs and verbalizations combined) on language comprehension in autistic children.

Statement of Hypotheses

This study was designed to investigate the following hypotheses.

1. There are no differences among the mean percentages of correct responses to probes using _1_ speech stimuli only, _2_ manual sign stimuli only, or _3_ simultaneous speech and manual sign stimuli for

autistic subjects who are taught a comprehension task using simultaneous communication.

2. There is no difference between the mean percentage of times autistic subjects who are taught using simultaneous communication will point to an object according to its verbal label and the mean percentage of times they will point to an object according to its manual sign label when an inappropriate association of a manual sign label and a verbal label is used as a probe stimulus.
3. There are no differences among the mean percentages of correct responses to probes for autistic subjects when _1_ simultaneous speech and manual signs, _2_ manual signs only, or _3_ speech only are used to teach a comprehension task.

Variables

The dependent variable in this study is comprehension of object labels by autistic children. The independent variables are the three components of simultaneous communication: _1_ signs, _2_ speech, and _3_ signs and speech together.

Subject Population

The children used in this study were selected from the population of children enrolled in classes for autistic children in a county public school system in the southeastern United States. The criteria for selection included a diagnosis of autism by an interdisciplinary team which included a child psychiatrist, normal hearing acuity judged by a standard pure tone hearing screening test, and the ability to maintain on-task behavior. Three of the five children in the class for autistic children met these criteria and were included in the study. Brief descriptions of these children follow; details of specific skills, developmental levels, and behavioral observations are included in Appendix A.

Subject A

Subject A is a 14.2 year-old severely autistic male who lives at home with his two parents and three siblings. His behavior is characterized by constant rocking motions of his head and trunk during sitting and standing. While rocking, Subject A periodically slaps his thigh, chest, or back and claps his hands several times. He also shakes his head frequently and laughs and grunts. Subject A exhibits severely aggressive behavior which includes injurious assaults on himself and others. He squeals, bites, pinches, scratches, and hits himself and others. These outbursts can be either provoked or in apparent response to frustration.

Subject A generally is quite cooperative during teaching sessions. He works well independently and is very motivated to finish tasks. He knows when he responds correctly and is very hesitant to guess when unsure of an answer; he looks to an adult for cues and will pinch and scratch the adult to prompt assistance.

Subject A has no oral communicative behaviors and uses only vague pointing to indicate wants; occasionally he grunts for recognition. He spontaneously signs for "toilet" and "coke" only, although he can make the manual signs for several other words.

Subject A was a normal baby until the age of 2 1/2 years. At this point in time his parents became concerned because his speech and language skills began to deteriorate. He was placed in a special education center when he was six years old and in classes for autistic children, his current placement, when eleven years of age. He has not received formal speech and language therapy and currently is instructed informally with simultaneous communication in the classroom.

Subject B

Subject B, a moderately autistic 8 1/2 year-old male, lives at home with his parents and three brothers. His behavior is characterized by a low tolerance for frustration; he frequently refuses to comply with requests and exhibits tantrums, some of which are prolonged and severe. When unoccupied subject B may stare toward the ceiling with intermittent attention to environmental stimuli.

Subject B can be very cooperative during individual training sessions. When involved in a preferred activity, he is interested in completing the task and exploring new materials. He attends well to instructions and responds immediately and enthusiastically.

Subject B has unintelligible speech consisting of a series of grunts which represent connected words. He actively gestures while making sounds and uses manual signs for some words. He has some words that are intelligible to those familiar with him. Subject B responds to questions with sounds and gestures and initiates communicative interactions with adults.

Subject B was considered to be a normal infant until the age of 18 to 24 months. At that time he began to appear increasingly socially withdrawn and his preoccupation with staring out of windows became noticeable. Additionally, his speech and language skills were not developing at the expected rate. Subject B was subsequently seen by a series of psychologists and diagnosed formally as autistic by the age of three years. He was placed in his current class for autistic children when he was four years old. Subject B receives formal speech and language training and is informally instructed in the classroom with simultaneous communication.

Subject C

Subject C, a 7.10-year-old male, is a mild to moderately autistic child who lives at home with his natural parents; he has no siblings. He is an active child whose behavior in unstructured situations is characterized by aimless wandering about the room, periods of blank staring with intermittent attention, spontaneous jumps up and down, and frequent biting on the backs of his hands. Subject C repeats phrases and sentences to himself, utters unintelligible jargon, and makes sounds to himself while he sits and works. He is attracted to visual stimulation and may jump from his chair during an activity to look at an object in another area of the room.

Subject C works very well in a structured teaching setting; he attends to directions, attempts all tasks presented to him, and works to complete activities. However, he is upset if not permitted to finish a task. He responds well to praise and shows some pride in his work.

Subject C communicates orally; he initiates verbal interchanges with adults by asking questions. His speech is characterized by delayed language and much echolalia; he repeats most questions that are asked of him, rarely uses pronouns, and has some difficulty with articulation.

Subject C's parents began to suspect developmental difficulties when speech and language skills had not appeared by 24 months of age. Behavior management became a serious problem at that time when he began to have severe tantrums. At age three years subject C was enrolled in a program for behavioral management and speech therapy. He began in the present class for autistic children when he was 5 years old. Presently, subject C receives speech therapy and is taught in the classroom with simultaneous communication. Subject C does not use manual signs to communicate; he speaks in short sentences.

Stimulus Material

Twenty-one objects were chosen for use in this study. The objects were of similar dimensions, ranging from 4 mm x 4 mm to 10 mm x 13 mm with color, texture, composition, and shape varying randomly among the objects (See Appendix B).

Nonsense words consisting of consonant-vowel-consonant combinations were selected randomly and assigned as a label to each object. Additionally, nonsense manual signs were devised as labels for each object. The number of hands needed to form the manual sign, the location of the sign with reference to the body, and the number of movements required to produce the sign varied randomly among the manual signs.

Each of the objects, words and manual signs was presented to three persons familiar with American Sign Language to be judged for recognition. No object, word, or manual sign was recognizable as meaningful prior to initiation of the study and each was consistently distinguishable from the others.

A list of the nonsense words and pictures of the nonsense objects and manual signs are located in Appendix B.

Experimental Setting

A 7' by 9' room which was connected to the children's classroom was used throughout the entire study for the collection of data. Lighting consisted of one 100 watt light bulb. The room contained no windows and all items in the room were stored behind closed cabinet doors leaving the room free of distracting stimuli. The door leading to the room was closed during experimental trials. Furnishings in the room were limited to one wooden table 24" by 18" and two small wooden chairs. A large piece of dark brown construction paper was taped to the top of the table to provide a distraction-free surface and even contrast with the stimulus objects.

The stimulus objects were stored in a small box on the floor by the experimenter's chair. The forms which were used to record responses were attached to a clipboard which remained on the experimenter's lap. All recording on the forms took place below the level of the top of the table and out of the subject's view. The edible reinforcers also were stored on the experimenter's lap.

The principal investigator presented all items to each of the subjects. Nonsense signs and nonsense words were produced with 100 percent accuracy, judged by an independent observer according to the standard prescribed by the principal investigator.

Instrumentation

Data collection forms were used to record the responses of the subjects on each trial throughout the study. These forms are available from the author. The forms indicated to the experimenter which object was to be labeled and the method of labeling for each trial in the study.

Specific Procedures

The following is a description of the specific methods and procedures used in this study.

Subject Selection

Following permission from the appropriate personnel within the local school system, the principal investigator spent two weeks in the classroom assisting the teacher and becoming familar with the five children in the class. After obtaining informed parental consent, all children (five) with the diagnosis of autism (made by an interdisciplinary team including a child psychiatrist) were screened for the ability to maintain on-task behavior. Each child was formally observed by the principal investigator during three individual teaching sessions with the classroom teacher and three group sessions. Each observation period was 15 minutes in length. Using a stop watch, the principal investigator categorized the child's behavior as either on-task or off-task every 15 seconds during the observation period. Those children with behavior that was on-task 60 percent of the time or more during individual work sessions were included. Three of the five children in the class met this criterion and were screened with conventional pure-tone audiometry.

A 25 dB hearing screening test was administered for the frequencies 250 Hz, 500 Hz, 1,000 Hz, 2,000 Hz, and 4,000 Hz by air conduction to the three children. The hearing test was conducted by a speech therapist who was certified by the American Speech and Hearing Association. All three children passed the hearing screening test and were therefore chosen as subjects for the study. Had more than three children in the class passed these criteria three subjects would have been selected randomly.

Acquisition of Descriptive Data

Following selection of the three subjects, the experimenter screened the receptive and expressive language skills, the severity of autistic behaviors, and overall developmental levels of each subject. The *Peabody Picture Vocabulary Test*, the *Preschool Language Scale*, the *Callier-Azusa Scale*, and the *Childhood Autism Rating Scale* were used. The results of these tests, which help to provide a detailed description of each subject included in the study, are presented in Appendix A.

Systematic behavioral observations of each of the subjects are included in Appendix A, as are results of past evaluations by school personnel and outside agencies. Each of the subjects' parents were interviewed to obtain historical data. Information from these interviews is assimilated into Appendix A.

Response Reinforcement

During the first two weeks in the classroom and subsequent behavioral observations and testing, various positive reinforcers were identified. All three subjects appeared to be inherently motivated to complete tasks given to them and they responded positively to food (popcorn, cola, peanuts, cookies, candy, cereal, french fries, crackers, cake, apples). Small fish-shaped crackers were selected as reinforcers to be paired with verbal reinforcement and smiling.

Experimental Sessions

Experimental sessions were conducted individually with each subject; sessions were held between 9:00 am and 11:00 am daily (excluding weekends). The child was seated across the table from and facing the experimenter; sessions began when the child was sitting quietly and attentively. The experimenter placed three stimulus objects on the table and labeled one of the objects according to the prescribed protocol. The object to be labeled and the method of labeling for each trial appeared on the response form.

The subject was allowed five seconds to point to the labeled object following presentation of the stimulus; the experimenter mentally counted five seconds after presenting the item. If no response was given within this time period or if an incorrect response was given, the experimenter recorded an incorrect response on the recording form. Appropriate reinforcers were given according to the specified reinforcement schedule on the response form. After the subject's response was recorded the objects were arranged again in random order in front of the subject to begin the subsequent trial. Trials continued until the subject reached the designated criterion level of performance.

Criterion Level of Performance

The criterion level of performance required in each section of the study was noted on the response form which the experimenter used. This was done not only to record the subjects' responses but also to determine the format for presentation of successive trails. Trials continued until the subject reached a stable level of responding. A stable level was defined as a change of plus or minus one item correct on three successive probes. Sidman (1960) recommends that behavior be within a five percent range of variability to be considered stable; plus or minus one item correct results in a variability ranging from 4 percent to 10 percent depending upon the section of the study. This range was considered acceptable since both Sidman (1960) and Hersen and Barlow (1976) acknowledge that a strict 5 percent range of variability may be difficult to achieve in clinical research. Maintenance of a plus or minus one item range of variability over three consecutive probes was used as a criterion to establish trends in the data based on the recommendation of Hersen and Barlow (1976) for this purpose.

Experimental Design

A single-subject experimental design was chosen for this study to facilitate an in-depth analysis of specific responses of selected autistic children to simultaneous communication and the relationship between their responses and learning behavior. Hersen and Barlow (1976) note that group design studies do not permit a detailed study of the relationship among an individual's responses to a series of experimental stimuli; data are grouped across subjects resulting in an overall description of the subject's performance instead of an analysis of the dynamics of each of the subject's responses. Because autistic children represent an extremely diverse population and educational and therapeutic decision-making for them necessarily occurs through detailed individual assessments, the appropriate unit of analysis for an in-depth study is the individual.

This study was divided into two separate sections to investigate the stated hypotheses. The single-subject experimental design used in section I of this study combines aspects of a withdrawal design, a concurrent schedule design, and a multiple schedule design.

The overall experimental design used in section I was an ABABA design with A representing baseline measurements and B representing the treatment phases. Each of two treatment conditions were presented individually and alternately within each of the B (treatment) phases. This aspect of the experimental design was based on the multiple schedule design outlined by Hersen and Barlow (1976). To minimize the effects of interaction and sequence, two separate B phases were needed to present the treatment conditions in alternating order. This replication of the B phase was used also to demonstrate the reliability of the data.

A concurrent schedule design was utilized for presentation of the stimulus conditions within each of the two treatment conditions. This design allowed for randomization of the stimulus conditions which controlled for biasing effects of interaction and sequence in this portion of the study.

A direct replication was used with a second subject in a generalization phase. Additionally, a third subject was used in the generalization phase to rule out sequence and interaction effects; the order of presentation of the two treatment conditions was reversed within the B phases compared to the order used with the other two subjects.

Figure 1 illustrates the experimental design which was used for section I of the study. The subjects were taught to point to an object which the investigator labeled using simultaneous communication (verbal label and manual sign label together). A baseline level of performance was collected and treatment phases were begun. Subjects 1 and 2 began with the investigator labeling the object using either the verbal label only or the manual sign label only as the stimulus for the subject to point to the object. After a stable level of responding was achieved, the investigator began treatment 2 by labeling the object using an inappropriate association of the manual sign label and the verbal label on some trials and an appropriate association on other trials. A return to baseline level of performance was begun after a stable level of responding had been recorded. These two subjects repeated the sequence with treatment 1 and treatment 2 in reverse order. The third subject began with the two treatments in opposite order from the first two subjects and ended with the treatments in reverse order.

The experimental design for section II of this study was a multiple schedule design, which is illustrated in Figure 2. Because three treatments were investigated, three subjects were needed to counterbalance equally the order of presentation of the treatments. The task was replicated once to demonstrate the reliability of the initial results.

Subject A & B	Baseline → T_1 → T_2 → Baseline → T_2 → T_1 → Baseline
Subject C	Baseline → T_2 → T_1 → Baseline → T_1 → T_2 → Baseline

Key:

Baseline = subject points to object investigator labels using simultaneous communication

T_1 = treatment 1 subject points to object investigator labels using either speech or manual sign

T_2 = treatment 2 subject points to object investigator labels using either an appropriate or inappropriate association of verbal label and sign label

Figure 1. Sequential phases in the experimental design for section I.

Subject A	$T_1 \rightarrow T_2 \rightarrow T_3 \longrightarrow T_2 \rightarrow T_3 \rightarrow T_1$
Subject B	$T_2 \rightarrow T_3 \rightarrow T_1 \longrightarrow T_3 \rightarrow T_1 \rightarrow T_2$
Subject C	$T_3 \rightarrow T_1 \rightarrow T_2 \longrightarrow T_1 \rightarrow T_2 \rightarrow T_3$

Key:

T_1 = treatment 1 subject points to object investigator labels using simultaneous communication

T_2 = treatment 2 subject points to object investigator labels using a manual sign only

T_3 = treatment 3 subject points to object investigator labels using a verbal label only

Figure 2. Experimental design for section II.

The order of presentation of the three treatments in the replication was randomized to minimize the effects of sequence and interaction.

Figure 2 shows that the treatments were counterbalanced over the three subjects in the first phase of this section of the study and also in the second phase, the replication. Subject A began with the investigator labeling the object using simultaneous communication while subject B began with the investigator labeling the objects using manual signs only. The third subject (C) began with the investigator labeling the objects using the verbal label only. Each subject received training with each of the three treatments.

To control for possible differences between treatments due to the stimulus objects, a supplementary treatment was administered after treatments two and three if the subject's baseline on either of those two treatments was less than 90 percent correct. Stimuli were presented using simultaneous communication during the supplementary treatment and treatment continued until the subject established a baseline.

Data Analysis

The raw scores of each subject on each of the six probes were converted to a percent to reflect percent correct. Hypotheses were tested by comparing percentages. A meaningful difference between percentages was regarded as a variation greater than 10 percent. A score of plus or minus one item correct was used to determine stable responding for the criterion level of performance throughout this study. This resulted in a variability of 4 percent to 10 percent. Because a value greater than 10 percent represented variability beyond stability for within subject responding, the same criterion was used to represent meaningful variability for hypothesis testing.

Confounding Variables

Facial expression, postural changes, and visual cuing during experimental sessions were identified as possible confounding variables. To control these variables an independent observer attended one randomly selected probe during each phase of the study for each subject. The observer sat behind and to the side of the subject and recorded changes in the investigator's behavior, on the observational record form (Appendix C), after each trial stimulus was presented and before the subject responded.

Summary

Three autistic children were taught to point to objects that were labeled using simultaneous communication, speech only, and manual signs only to investigate the effects of the components of simultaneous communication (manual signs, verbalizations, and manual signs and verbalizations combined) on comprehension. Single-subject experimental designs were used. A basic ABABA design and a multiple schedule design constituted the overall experimental design of the study.

Twenty-one nonsense objects with corresponding nonsense manual signs and nonsense labels were used as stimulus material. Using these materials, the principal investigator individually trained each of the three subjects.

CHAPTER IV
RESULTS

The primary purpose of this study was to investigate those components of simultaneous communication which enhance receptive language in autistic children. The data were gathered through individual sessions with each of three subjects in a single-subject experimental design.

The results of this study are presented in graphic form. Each section of the study is analyzed separately according to these topics: 1) intrasubject variability, 2) intersubject variability, 3) variability among components, 4) reliability, and 5) treatment effects.

Results of Section I

In section I of this study the investigator taught the subjects to point to objects, which the investigator labeled using simultaneous communication, to study the effects that each of the component parts of simultaneous communication (the speech, the manual signs) individually may have on the subjects' responses. Two separate treatments were administered in this section of the study. In treatment 1 the subjects were asked to identify objects in probes which used simultaneous manual signs and verbal labels, manual signs only, and verbal labels only. In treatment 2 the subjects were presented with an inappropriate association of a manual sign label and a verbal label and were requested to select the object that was being labeled.

Briefly, the results of section I were that one subject attended only to the manual sign component of simultaneous communication ignoring the verbal stimulus, one subject attended only to the verbal component and ignored the manual sign, and the third subject attended to both components but preferred the verbal stimuli. Thus, a single component of simultaneous communication was found to be responsible for responses made to stimulation which used simultaneous communication. Replication of the tasks resulted in the same findings. Because of the distinct variability between the subjects, opposing results were found when the data were grouped for analysis; both components combined in simultaneous communication appeared to be more effective than either of the components separately.

Intrasubject Variability

The effects of the treatments were examined separately to determine if either of the components of simultaneous communication was as effective in a comprehension task as both components combined in simultaneous communication for a given subject.

Treatment 1. To investigate the possible differences among probes using 1 speech only, 2 manual signs only, and 3 simultaneous communication for each subject the following hypothesis was tested:

> there is no difference among probes using 1 speech only, 2 manual signs only, 3 simultaneous communication by each subject who was taught a comprehension task using simultaneous communication.

This hypothesis was rejected for subjects A and C but retained for subject B. The data from treatment 1 indicate that the separate components of simultaneous communication are just as effective when used alone as they are when combined in simultaneous communication.

Figure 3 shows that subject B identified the stimulus objects with 100 percent accuracy when probed using simultaneous communication. Similarly, when only the manual signs were used as a probe stimulus his mean percentage of correct responses was 99. His performance was identical when only the verbal label was used as well ($\bar{X}$ = 100 percent correct). After learning to identify objects which were labeled using simultaneous communication, this subject was able to identify the same objects with the same degree of accuracy when only the verbal label was presented or when only the manual sign label was presented; the subject was attending to both of the available stimuli in simultaneous communication.

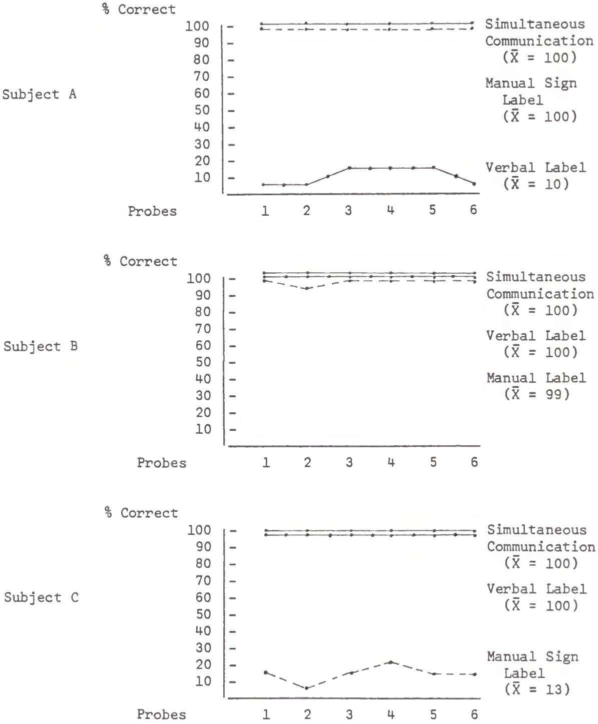


Figure 3. Performance of Subject A, B, and C, who were taught to point to objects using simultaneous communication, on probes using simultaneous communication, the verbal label only, or the manual sign label only.

The stated hypothesis was rejected for subject A since this subject identified the stimulus objects correctly with 100 percent accuracy when both the verbal label and the manual sign label were presented and also when just the manual sign label was presented. However, when the manual sign label was withdrawn and just the verbal label was used, the subject's accuracy fell to 10 percent correct over six separate probes. Figure 3 shows the distinct difference between the three probe conditions. The subject appeared to be attending to only the manual sign component.

Figure 3 also depicts the performance of subject C. The figure shows that subject C was able to identify correctly the stimulus objects with 100 percent accuracy when simultaneous communication was used as a probe stimulus. However, when the verbal label was withdrawn the subject identified the stimulus objects correctly on fewer probes ($\bar{X}$ = 13). When the manual sign label was withdrawn, however, the subject identified the objects with 100 percent accuracy just as when both the manual sign label and the verbal label were used simultaneously. The hypothesis for treatment 1 was rejected for this subject since the subject was not able to identify the objects with the same degree of accuracy when the manual sign label was used alone as when it was used in conjunction with the verbal label. The subject appeared to be attending only to the verbal component of simultaneous communication.

Treatment 2. To investigate the possible differences between the reliance on the verbal cue in simultaneous communication compared to the reliance on the manual sign cue in simultaneous communication of each individual subjects, the following hypothesis was tested:

> there are no differences between the percentage of times the subject will point to an object according to its verbal label and the percentage of times he will point to an object according to its manual sign label when an inappropriate association of a manual sign label and a verbal label is used as a probe stimulus.

This hypothesis was rejected for all three subjects. Each subject showed a preference for one of the labels over the other (either the verbal label or the manual sign label); two subjects relied on the verbal cues and one subject relied on the manual sign cues. No subject relied on a combination of the two cues to identify the stimulus objects; identification with the preferred component was as effective as identification with both components combined.

Each of the three subject was able to identify the stimulus objects with 100 percent accuracy when a correct association of a manual sign label and a verbal label was used as a probe stimulus. Figure 4 shows that when an inappropriate association of a manual sign label and a verbal label was presented to subject A, the subject pointed to the object whose manual sign label was presented in the

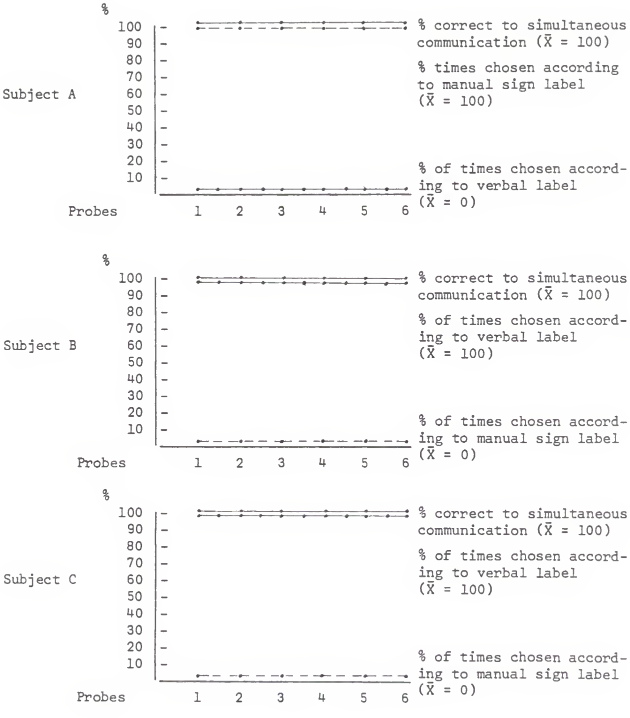


Figure 4. Performance of Subject A, B, and C who were taught to point to objects using simultaneous communicating when an inappropriate association of a manual sign label and verbal label was presented.

probe stimulus. The subject never selected the object whose verbal label was presented. The subject was attending only to the manual sign component of simultaneous communication.

Figure 4 indicates that subjects B and C exhibited behavior directly opposite to that of subject A. Subjects B and C selected the object whose verbal label was presented in the stimulus probe and never selected the object whose manual sign label was presented. Therefore, after learning to select the object that the investigator labeled using simultaneous communication subject B and C consistently chose the object whose verbal label was presented when the investigator used an inappropriate association of a verbal label and a manual sign label as a probe stimulus. Subject A, however, consistently chose the object whose manual sign label was presented. While Subject A attended only to the manual signs, subject B and C attended only to the verbal component of simultaneous communication.

Intersubject Variability

The differences among the three subjects on each of the two treatments was examined to determine if either of the components of simultaneous communication was as effective in a comprehension task as both components combined in simultaneous communication.

Treatment 1. To assess the possible differences among the three subjects on probes using 1 speech only, 2 manual signs only, or 3 simultaneous communication the following hypothesis was tested:

> there are no differences among the three subjects who are taught a comprehension task using simultaneous communication on probes using 1 speech stimuli only, 2 manual sign stimuli only, or 3 simultaneous communication.

Hypothesis 1, that there are no differences among the three subjects on probes using speech stimuli only, was rejected. Figure 5 shows that both subjects B and C responded to probes using only speech stimuli with 100 percent accuracy on each of the six probes. Subject A's performance was distinctly different. After being taught to point to objects using simultaneous communication as labels, subject A was able to identify the same objects correctly with only 10 percent accuracy when the objects were labeled with only their verbal label. Thus, the subjects responded differently to the speech component of simultaneous communication; two subjects responded positively, and one did not.

Hypothesis 2, that there are no differences among the three subjects on probes using manual sign stimuli only, was rejected. While both subjects A and B were able to identify the stimulus objects with a mean percent correct of 100 and 99 respectively over all six probes when only manual signs were used to label the objects, subject C was able to perform the task with an average of 80 percent correct over the

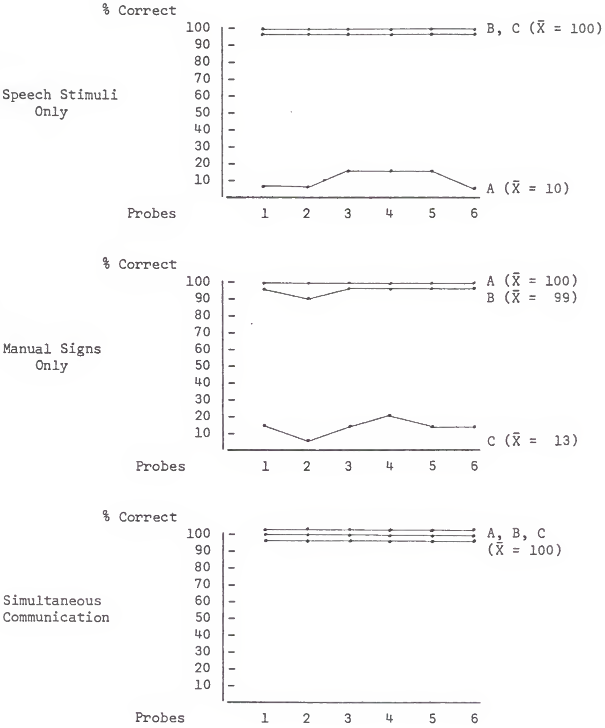


Figure 5. Percentage of correct responses on probes which used speech stimuli only, or manual signs only or simultaneous communication by Subject A, B, and C who were taught using simultaneous communication.

six probes. Figure 5 shows the performance of the three subjects on all six probes, illustrating the consistently meaningful difference between subjects A and B and subject C. Two subjects (A and B) achieved a consistently high level of performance when exposed to the manual sign component and one subject (C) did not.

Hypothesis 3, that there are no differences among the subjects on probes using simultaneous communication stimuli, was retained. Figure 5 indicates that after the subjects were taught to point to the stimulus objects using simultaneous communication stimuli, all of the subjects maintained 100 percent accuracy in performing the task throughout the study.

The data from this section of the study indicate that the subjects responded differently to training using simultaneous communication. The verbal component was ignored as a cue by one subject (A) while the manual sign component was ignored as a cue by another subject (C); one component was as effective as both components combined in simultaneous communication. For the third subject (B), _either_ of the components _separately_ was as effective as the combination of the two components in simultaneous communication.

Treatment 2. To assess the possible differences among the three subjects in response to treatment 2 the following hypothesis was tested:

> there are no differences among the three subjects taught a comprehension task using simultaneous communication stimuli *1* in the percentage of times the subjects point to an object according to its verbal label and *2* the percentage of times they point to an object according to its manual sign label when an inappropriate association of a manual sign label and verbal label is used as a probe stimulus.

Figure 6 shows that throughout this portion of the study the subjects consistently identified the stimulus objects correctly when presented with labels using simultaneous communication. When an inappropriate association of a manual sign label and a verbal label was presented as a probe stimulus, however, subjects B and C pointed to the object in response to the verbal label which was used in 100 percent of their responses whereas subject A never responded according to the verbal label (Figure 6). Therefore, hypothesis 1, that there is no difference among the three subjects in the percentage of times they point to an object according to its verbal label, is rejected.

Hypothesis 2, that there is no difference among the three subjects in the percentage of times they point to an object according to its manual sign label when an inappropriate association of a manual sign label and verbal label is presented as a probe stimulus, was rejected. Figure 6 shows that both subjects B and C never selected an object according to its manual sign label while subject A did so in

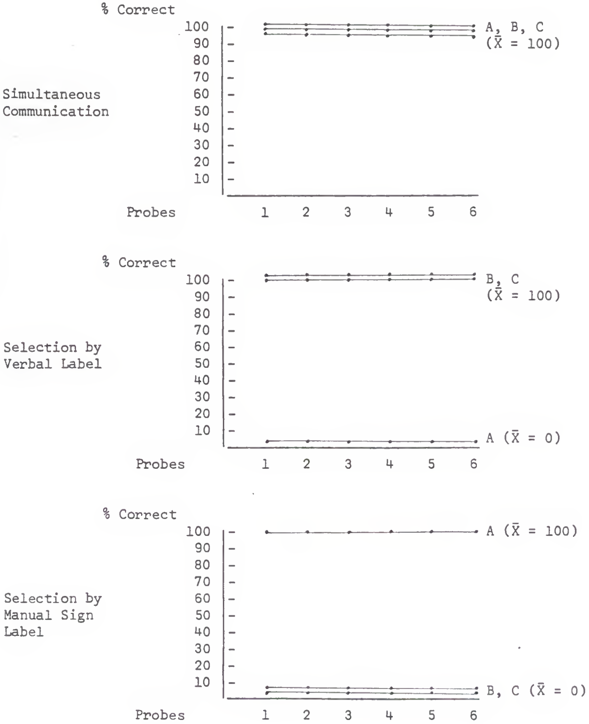


Figure 6. Percentage of correct responses by Subject A, B, and C who were taught using simultaneous communication, to probes using simultaneous communication and the percentage of times objects were selected according to their verbal label or their manual sign label when an inappropriate association of labels was used as a probe stimulus.

100 percent of his responses. Therefore, there is a meaningful difference between subject A and the other two subjects. Subject A consistently responded to the manual sign label and the other two subjects (B and C) did not.

The data from this section of the study indicate that when both manual signs and speech are used to teach a subject to identify an object and the subject is subsequently compelled to choose one of the components to identify the object, two subjects (B and C) used the verbal component for identification and one (subject A) used the manual sign component. Furthermore, the single component the subjects chose produced the same result as both components combined in simultaneous communication.

Variability Among Components (Grouped Data)

For each of the two treatments, the effects of the components of simultaneous communication were examined to determine if there were any differences among the components compared to simultaneous communication.

Treatment 1. To investigate the possible differences among probes using 1 speech only, 2 manual signs only, and 3 simultaneous communication, for all three subjects combined the following hypothesis was tested:

> there is no difference among probes using 1 speech only, 2 manual signs only, and 3 simultaneous communication in subjects who are taught a comprehension task using simultaneous communication.

This hypothesis was rejected. The data from this section of the study indicate that when both manual signs and speech (simultaneous communication) are used to teach a subject to point to a labeled object, both of the components (the manual signs and the speech) are used as cues for identification of the object; neither of the components separately can produce the same result.

Figure 7 illustrates that there is a meaningful difference between probes using speech stimuli and probes using simultaneous communication and between probes using manual sign stimuli and probes using simultaneous communication. The mean percent correct on probes using simultaneous communication was 100. The mean percent correct on probes using speech stimuli only was 70 and similarly, the mean percent correct on probes using manual sign stimuli only was 71 percent correct.

Figure 7 shows that the subjects, who learned to point to objects when the investigator labeled the object using simultaneous communication, were not able to identify the same objects with the same degree of accuracy when they were asked to point to the objects using speech only or manual signs only. The percentage of correct responses made when manual signs were used to label the objects ranged from 66 to 73 percent correct. A similar level of correct responding was noted when speech stimuli only were used (69 percent to

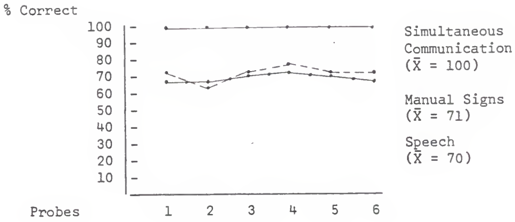


Figure 7. Percentage of correct responses on probes requiring identification of objects labeled using two methods by the group of subjects who were taught using simultaneous communication.

71 percent). Figure 7 shows that when manual signs and speech stimuli were combined the percent correct rose to 100 percent on each probe. Clearly, the data indicate opposite results when combined compared to analysis of each subject's performance separately due to the intersubject variability.

Treatment 2. To investigate the overall reliance on verbal cues in simultaneous communication compared to the overall reliance on manual sign cues in simultaneous communication the following hypothesis was tested:

> there is no difference between the percentage of times subjects who are taught to point to objects using simultaneous communication point to an object according to its verbal label and the percentage of times they point according to its manual sign label.

The hypothesis was rejected. The data from this section of the study indicate that when subjects are taught using manual signs and speech combined to identify objects and then are compelled to choose one of the components to identify an object, the verbal cue is used most often for identification.

The mean percentage of responses made according to the object's verbal label was 67 while the mean percentage of responses made according to the manual sign label was 33. Because the difference between the two treatment conditions was greater than 10 percent, the difference was considered to be meaningful. Therefore, the data indicate that subjects chose objects according to the verbal label more often than according to the manual sign label.

Figure 8 shows that when the subjects were asked to point to an object labeled using simultaneous communication the correct object was identified with 100 percent accuracy in each probe. The figure further shows that when an inappropriate association of the verbal label and the manual sign label was used as a stimulus, objects were selected according to their verbal label more frequently than according to their manual sign label in each of the six probes. In general, the subjects appeared to be attending to the verbal component in simultaneous communication.

Reliability

Each of the treatments was repeated with each of the subjects to demonstrate the reliability of the data.

Treatment 1. To assess the possible differences between treatment 1 and the replication of treatment 1 in each individual subject the following hypothesis was tested:

> there is no difference between the first three probes of treatment 1 which use 1 speech stimuli only 2 manual sign stimuli only, and 3 simultaneous communication and the replication of treatment 1 which involves three additional probes.

This hypothesis was retained for all three treatment conditions (speech stimuli only, manual sign stimuli only,

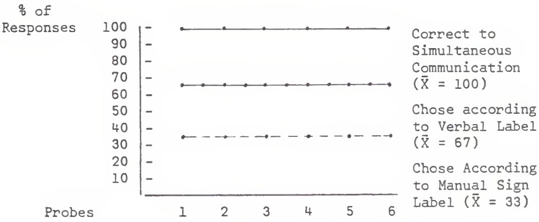


Figure 8. Percentage of times the group of subjects, taught to identify objects labeled using simultaneous communication, chose objects by their verbal label or by their manual sign label when an inappropriate association of the verbal label and manual sign label was used as a probe stimulus.

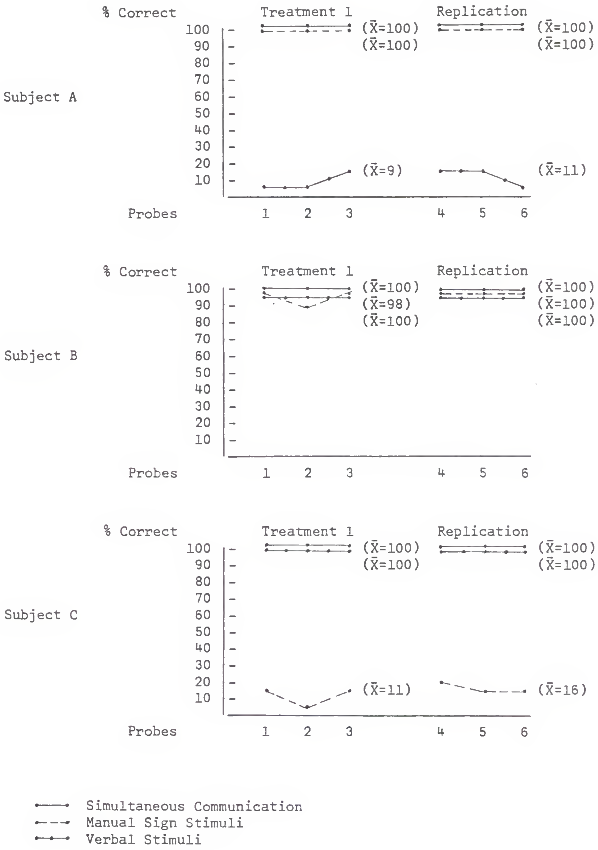
simultaneous communication) in each of the three subjects. The data from this section of the study indicate that the performance of the subjects in treatment 1 was not likely to be a chance event since their performance was the same during a replication of treatment 1.

Figure 9 shows the performance of subject A during treatment 1 and the replication of treatment 1. The figure indicates that subject A attained identical scores during the replication of probes using simultaneous communication and probes using manual sign stimuli only. The difference between the first three probes using verbal stimuli only and the replication of these probes was 2 percent and therefore not considered a meaningful difference.

The performance of subject B was extremely stable from the first three probes for each of the three treatment conditions to the replication. This subject maintained 100 percent correct responding on probes using simultaneous communication and verbal stimuli only. The difference between the treatment and the replication for probes using manual signs only was 2 percent. This difference of 2 percent was not considered meaningful. Figure 9 illustrates the performance of subject B on each of the six probes and shows the consistency of responding.

The previously stated hypothesis was also retained for subject C. A meaningful difference between the treatment

Figure 9. Percentage of correct responses by subjects A, B, and C on the first three probes of treatment 1 and the subsequent replication involving three additional probes.


% Correct
Treatment 1
Replication
100
90
80
70
60
50
40
30
20
10
Subject A
(X̄=100)
(X̄=100)
(X̄=9)
(X̄=100)
(X̄=100)
(X̄=11)
Probes
1
2
3
4
5
6
% Correct
Treatment 1
Replication
Subject B
(X̄=100)
(X̄=98)
(X̄=100)
(X̄=100)
(X̄=100)
(X̄=100)
Probes
1
2
3
4
5
6
% Correct
Treatment 1
Replication
Subject C
(X̄=100)
(X̄=100)
(X̄=11)
(X̄=100)
(X̄=100)
(X̄=16)
Probes
1
2
3
4
5
6
Simultaneous Communication
Manual Sign Stimuli
Verbal Stimuli

probes for each of the three conditions and the replication of the probes was not found. Figure 9 indicates that no difference was found between the three treatment probes using simultaneous communication and verbal stimuli only and the replication of these probes. A difference of 5 percent was found between the first three probes using manual signs only and the replication of this probe. This was not considered a meaningful difference.

The data show that the performance of each of the subjects on each of the tasks in treatment 1 was replicable.

Treatment 2. To assess the possible differences between treatment 2 and the replication of treatment 2 in each individual subject the following hypothesis was tested:

> there is no difference between the first three probes of treatment 2 and the replication of treatment 2 for each of the behaviors measured (percentage of times verbal label used, percentage of times manual sign label used, percentage of responses to simultaneous communication correct) for each of the three subjects.

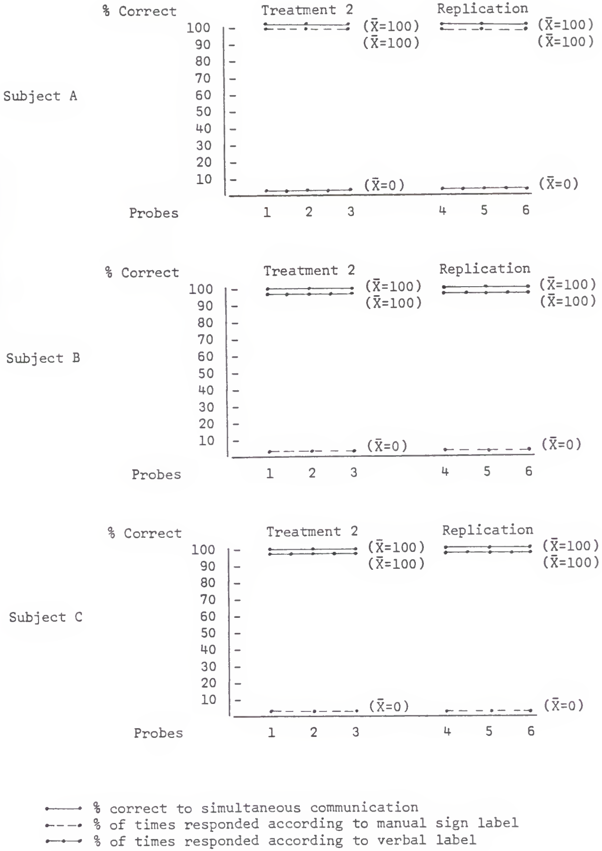
This hypothesis was retained for all subjects. Each of the subjects performed identically on each of the three measures of treatment 2 compared to the replication of each of the three measures. The data indicate that the performance of each of the subjects on treatment 2 was not likely a chance event since each of the subjects performed similarly during a replication of the treatment.

Figure 10 shows the performance of subject A who attained 100 percent correct on the probes using an appropriate association of a manual sign label and a verbal label (simultaneous communication) during the three treatment probes and the subsequent replication of the three probes. Similarly, this subject consistently responded according to the manual sign label when an inappropriate association of a manual sign label and a verbal label was used as a probe stimulus ($\bar{X}$ = 100 during the treatment and the replication). Further, no difference was found between the percentage of times the subject responded according to the verbal label during the treatment and the replication probes ($\bar{X}$ = 0).

The hypothesis was retained for subject B. No difference was found between his performance during the three probes of treatment 2 when an appropriate association of manual signs and verbal labels was used (simultaneous communication) and his performance during the replication of this treatment. Similarly, Figure 10 shows that he consistently responded according to the verbal label instead of the manual sign label when an inappropriate association of a manual sign label and verbal label was used as a probe stimulus in both the treatment probes and the replication probes.

Figure 10 shows that subject C responded to treatment 2 in the same manner as subject B. No differences were found

Figure 10. Responses by subjects A, B, and C on the first three probes of treatment 2 and the subsequent replication.


% Correct
Treatment 2
Replication
(X̄=100)
(X̄=100)
(X̄=100)
(X̄=100)
100
90
80
70
60
50
40
30
20
10
Subject A
(X̄=0)
(X̄=0)
Probes
1
2
3
4
5
6
% Correct
Treatment 2
Replication
(X̄=100)
(X̄=100)
(X̄=100)
(X̄=100)
Subject B
(X̄=0)
(X̄=0)
Probes
1
2
3
4
5
6
% Correct
Treatment 2
Replication
(X̄=100)
(X̄=100)
(X̄=100)
(X̄=100)
Subject C
(X̄=0)
(X̄=0)
Probes
1
2
3
4
5
6
% correct to simultaneous communication
% of times responded according to manual sign label
% of times responded according to verbal label

between the treatment probes and the following replication probes. Therefore, the stated hypothesis was retained. This subject maintained 100 percent correct responses to probes using an appropriate association of a manual sign label and a verbal label (simultaneous communication) throughout this section of the study. Additionally, he consistently responded according to the verbal label instead of the manual sign label when an inappropriate association of a manual sign label and a verbal label was presented as a probe stimulus.

The data show that each of the subject's performances were replicable.

Treatment Effects

To assess possible effects of the treatments on subsequent baseline levels of responding throughout section I of this study the following hypothesis was tested:

> there is no difference among baseline 1, baseline 2, and baseline 3 in any of the three subjects.

This hypothesis was retained for all subjects. No meaningful difference among the three baselines was found in the performance of any of the three subjects. The data indicate that the treatment phases did not alter any subject's baseline level of responses; the replication phase began with each of the subjects responding as he did prior to initiation of the first probe of the treatment phase in the study.

Figure 11 shows that each baseline (A_1, A_2, and A_3) was maintained at 100 percent correct by each of the subjects throughout the study. After each treatment phase the baseline returned to its previous level.

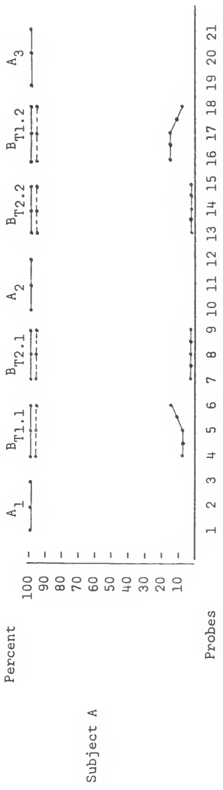
Results of Section II

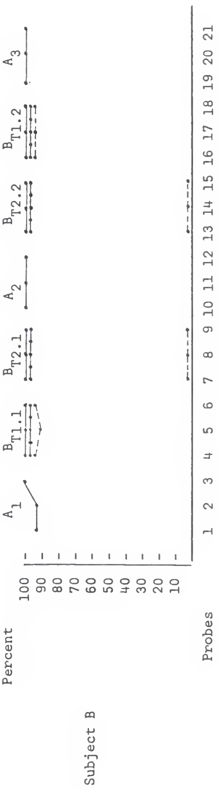
In section II of this study the investigator taught the subjects to point to labeled objects to study the effects each of the components of simultaneous communication may have on facilitation of comprehension skill. Three separate treatments were conducted: teaching using simultaneous communication, teaching using manual signs only, and teaching using speech only.

Briefly, the results of section II were that one component of simultaneous communication was necessary for facilitation of comprehension. The necessary component was specific to the individual subject and varied among subjects. While the addition of the second component of simultaneous communication to the necessary component did not enhance learning, the absence of the necessary component impaired learning. Thus, simultaneous communication did not enhance or inhibit comprehension.

Intrasubject Variability

For each subject the effects of each of the treatments were examined to determine if any one of the teaching


Percent
100
90
80
70
60
50
40
30
20
10
Probes
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
A1
BT1.1
BT2.1
A2
BT2.2
BT1.2
A3
Subject A


Percent
100
90
80
70
60
50
40
30
20
10
Probes
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
A1
BT1.1
BT2.1
A2
BT2.2
BT1.2
A3
Subject B

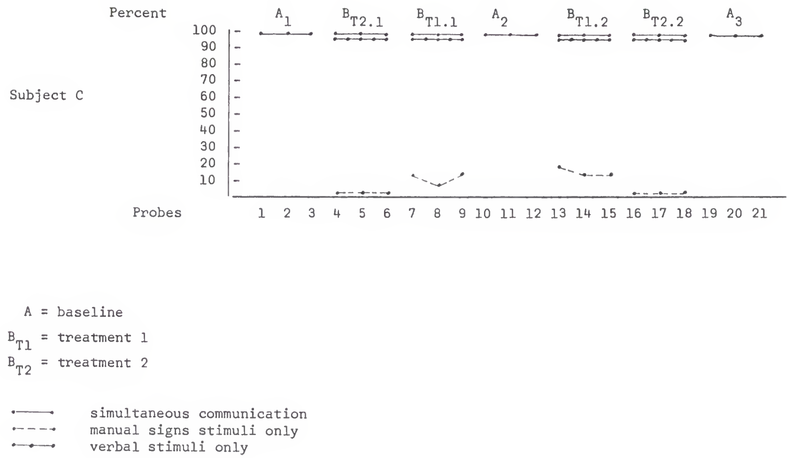


Figure 11. Results of baseline phases (A) and treatment phases (B) of section I.

methods was most effective for teaching a comprehension task.

To investigate the possible differences among the three teaching methods for each subject the following hypothesis was tested:

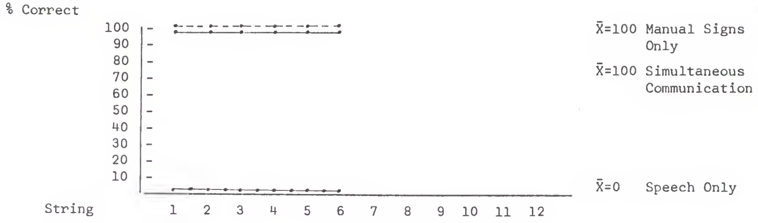
> there is no difference among responses to teaching using _1_ simultaneous communication, _2_ manual signs only, _3_ speech only.

This hypothesis was rejected for all subjects; one teaching method was found to be less effective than the other two with the particular method varying among the subjects. The data from this part of the study indicate that one separate component of simultaneous communication is the most effective teaching method for a given subject and that particular component is just as effective alone as it is when combined in simultaneous communication.

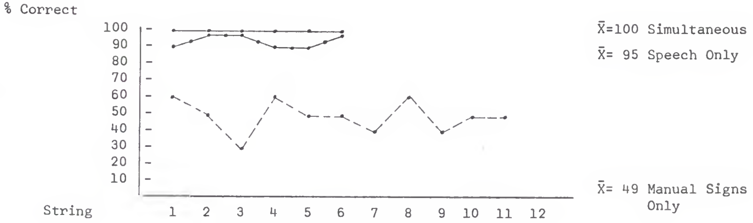
Figure 12 shows that subject A achieved 100 percent correct when taught with manual signs only or with simultaneous communication (manual signs with speech). However, when subject A was taught using speech stimuli only performance dropped to 0 percent correct. Clearly, a difference between teaching methods existed for this subject. The subject required manual signs for learning.

The stated hypothesis also was rejected for subject B since he achieved at 49 percent correct when he was taught

Subject A



Subject B



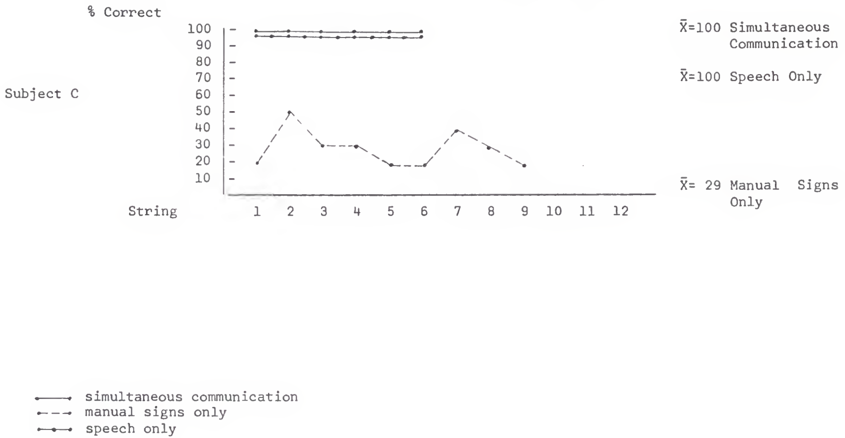


Figure 12. Percentage of correct responses by subject A, B, and C to each of three teaching methods.

using manual signs only but achieved at 95 to 100 percent correct when taught using speech stimuli only or simultaneous communication, respectively. The difference between his performance from teaching using simultaneous communication and teaching using speech stimuli only was not considered to be a meaningful difference since the value was less than 10 percent. The subject appeared to be learning through the verbal cues.

Figure 12 shows that similar results were obtained for subject C. No difference was found between subject C's performance when teaching was conducted with speech stimuli only or when teaching used both speech and manual signs together. The stated hypothesis was rejected, however, since subject C achieved at 29 percent correct when teaching was comprised of manual sign stimuli only. The difference between simultaneous communication ($\bar{X}$ = 100) or speech only ($\bar{X}$ = 100) and teaching using manual sign stimuli only ($\bar{X}$ = 29) was considered meaningful. The subject learned through the verbal stimuli which were presented.

Intersubject Variability

The differences among the three subjects on each of the three treatments were examined to determine if any one of the teaching methods was superior to the other two for teaching a comprehension task.

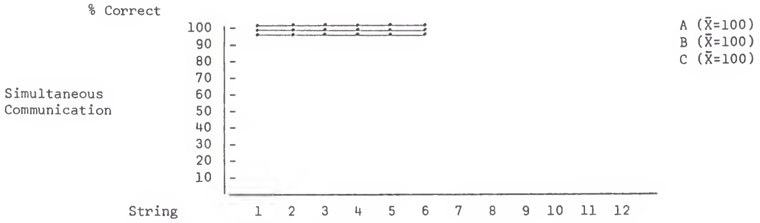
To investigate the possible differences among the subjects to teaching using 1 simultaneous communication, 2 manual signs, or 3 speech, the following hypothesis was tested:

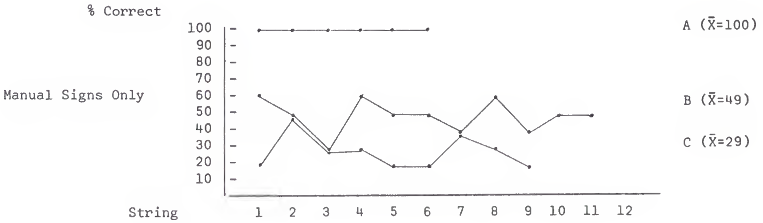
> there are no differences among the three subjects to teaching using 1 simultaneous communication, 2 manual signs only, or 3 speech only.

The above hypothesis was rejected for teaching using manual signs only and teaching using speech only and retained for teaching using simultaneous communication. The data from this section of the study indicate that teaching using simultaneous communication was equally effective for all subjects and was comparable to teaching using one component of simultaneous communication, however, the particular component varied among the subjects.

Figure 13 shows that all three subjects achieved at 100 percent accuracy when taught using simultaneous communication. Therefore, the stated hypothesis was retained for teaching using simultaneous communication since no difference among the subjects was evident.

Figure 13, however, illustrates the different responses among the subjects to teaching using manual signs only. When the verbal component of simultaneous communication was withdrawn from the teaching situation, a meaningful difference was found between subject A, who maintained 100 percent accuracy,


% Correct
Simultaneous
Communication
100
90
80
70
60
50
40
30
20
10
String
1
2
3
4
5
6
7
8
9
10
11
12
A (X̄=100)
B (X̄=100)
C (X̄=100)


% Correct
Manual Signs Only
100
90
80
70
60
50
40
30
20
10
String
1
2
3
4
5
6
7
8
9
10
11
12
A (X̄=100)
B (X̄=49)
C (X̄=29)

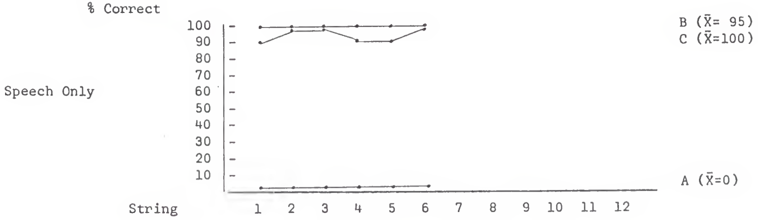


Figure 13. Percentage of correct responses by subject A, B, and C when taught with simultaneous communication, manual signs only, and speech only.

and subjects B and C whose performances declined. Subject A appeared to learn effectively when taught with manual signs while subjects B and C did not.

When the manual sign component of simultaneous communication was withdrawn from the teaching situation and teaching was conducted using speech stimuli only, a meaningful difference between the performance of subject A and subjects B and C was evident. Both subjects B and C performed similarly, achieving at 95 and 100 percent correct respectively; however, subject A's performance dropped to 0 percent correct. Figure 13 shows this difference among the subjects to teaching with speech stimuli only. Both subjects B and C appeared to learn through the verbal component, while subject A was not able to achieve without the manual signs.

Variability Among Components (Grouped Data)

The effects of the components of simultaneous communication were examined to determine if there were any differences between the components compared to simultaneous communication.

To investigate the possible differences among responses to teaching using 1 simultaneous communication, 2 manual signs only, and 3 speech stimuli only for all three subjects combined, the following hypothesis was tested:

This hypothesis was rejected. The data from this section of the study indicate that when both manual signs and speech are used to teach subjects to point to a labeled object their responses are considerably better than when only one of the components is used for teaching; neither of the components separately produces the same result. The data suggest that both the manual sign and the verbal label are used as cues for identification of the labeled object.

Figure 14 shows the difference between the three teaching methods. No meaningful difference was found between teaching using speech only and teaching using manual signs only. The difference between the two methods is 10 percent. A difference greater than 10 percent is considered a meaningful difference. Figure 14 shows that there is a meaningful difference between teaching with either of the components separately and teaching using simultaneous communication with simultaneous communication producing the better results. The results of the data combined differ with the results reported when the data were analyzed for each subject separately due to the intersubject variability.

Reliability

Each of the teaching methods was repeated with each of the subjects to demonstrate the reliability of the data.

To assess the possible differences between the first administration of each of the treatments and the replication of the treatments, the following hypothesis was tested:

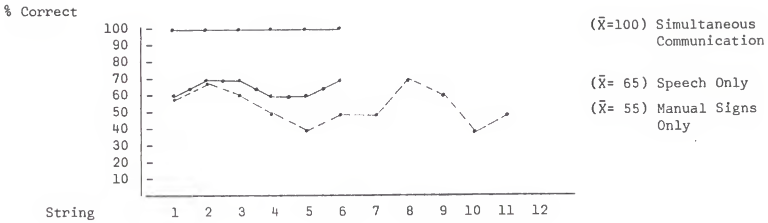


Figure 14. Percentage of correct responses by the group of subjects to three teaching methods.

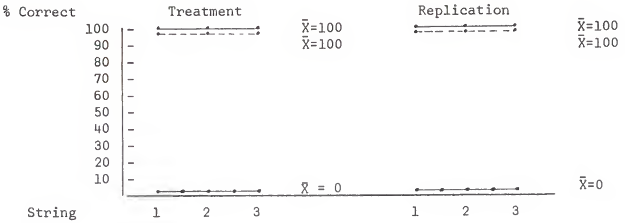
> there is no difference between the first administration of teaching using simultaneous communication, teaching using manual signs, and teaching using speech only and the replication of each of these treatments.

This hypothesis was retained for each of the treatment conditions for each of the subjects. The data indicate that the performance of each of the subjects during each of the three treatment conditions was not likely to be due to chance factors; the subjects responded the same when different stimuli were presented for a second time in the same manner as was presented the first time. Responses were not affected by different stimuli or other extraneous factors.

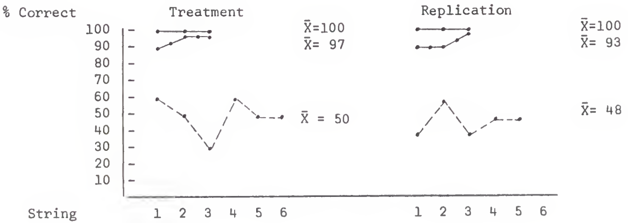
Figure 15 shows that subject A responded exactly the same during the replication of the treatments as he did during the first administration. This subject achieved 100 percent accuracy when teaching was conducted using manual signs, whether the manual signs were accompanied by speech stimuli or not.

There was no difference between the responses that subject B made during the first administration of the treatments and the replication. Figure 15 shows subject B's performance and suggests that subject B performed near 100 percent correct when teaching incorporated verbal stimuli. The addition of manual signs to the verbal stimuli made no difference in his responses.

Subject A



Subject B



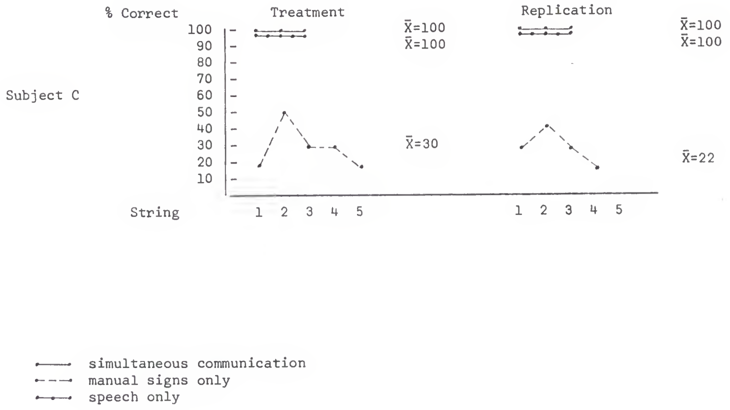


Figure 15. Percentage of correct responses by subject A, B, and C during the first administration of each of the treatments and the replication.

Similar results were obtained for subject C. Figure 15 shows that subject C's performance was no different during the replication than during the initial administration of the treatments. The figure further shows that subject C responded with a high degree of accuracy when verbal stimuli were used whether or not manual signs were used. This response pattern was consistent from the first administration to the replication of the treatments.

Treatment Effects

To assess the possible effects of variations in the stimulus material on responses to the treatment conditions, a supplementary treatment of teaching using simultaneous communication was instituted if a subject failed to reach 90 percent correct with either of the treatments involving the single components of simultaneous communication.

To compare the differences between the subject's response to simultaneous communication during the treatment phase and the subject's response to simultaneous communication during the supplementary treatment phase, the following hypothesis was tested:

> there is no difference between the subject's response to simultaneous communication during the treatment phase and the subject's response to simultaneous communication during the supplementary treatment phase.

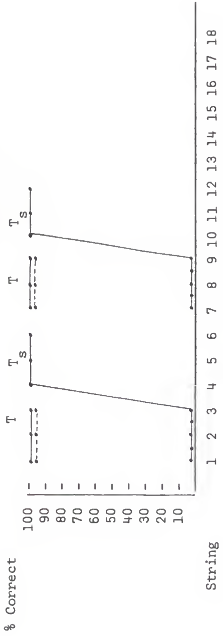
This hypothesis was retained for all subjects. The data indicate that the subjects' poor response to one of the treatments was not due to the stimulus material but rather due to the treatment itself.

Figure 16 shows that when simultaneous communication was used for teaching after teaching with one of the components separately, each of the subjects' responses were identical to the responses obtained during the treatment phase which used simultaneous communication for teaching. Subject A was not able to identify any of the stimulus objects correctly when taught using verbal stimuli only. However, when manual signs were added, his performance improved and was identical to that obtained during treatment using simultaneous communication.

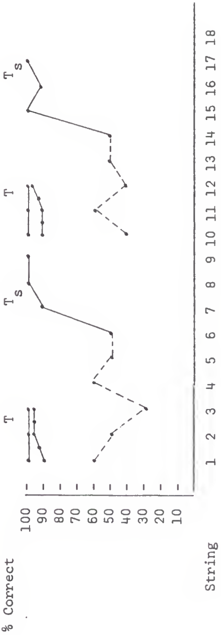
Similar results were noted for both subjects B and C. Both of these subjects had difficulty identifying the stimulus objects when only manual signs were used for teaching. When verbal labels were added to the teaching method, their performance became identical to that obtained during the treatment session in which simultaneous communication was used. Figure 16 shows their performance on the supplementary treatment using simultaneous communication and their performance during the treatment phase.

Summary

The results of this study were presented separately for section I and section II. Graphs and percentages were used to illustrate the differences. The data were examined for



Subject A



Subject B

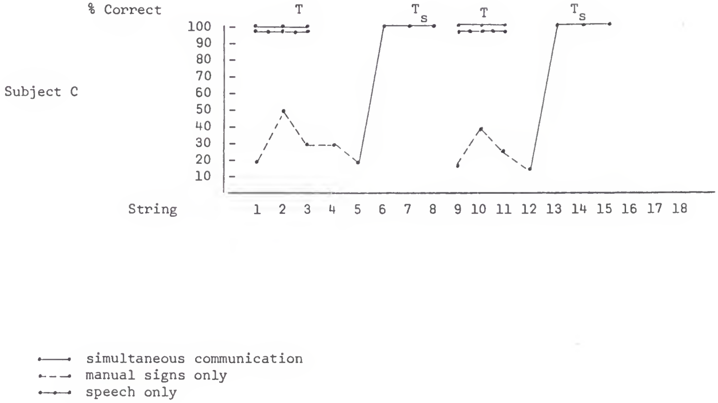


Figure 16. Percentage of correct responses by subject A, B, and C during each treatment (T phase) and during the supplementary treatment (T_s).

differences within each of the subject's performances, differences among the components of simultaneous communication, and differences among the three subjects. Furthermore, the data were analyzed to determine the reliability of each of the subjects' responses to each of the treatment conditions.

CHAPTER V
DISCUSSION AND CONCLUSIONS

In this study several hypotheses concerned with simultaneous communication and autistic children were investigated. The focus was on possible differences between their responses to the manual sign component and the speech component of simultaneous communication compared to their responses to a combination of the two components. The subjects' preference for one component over another and the effectiveness of each of the components for teaching a comprehension task were analyzed. Differences among the three subjects also were investigated.

Significance

The ability to use a system of arbitrary signals for communication not only distinguishes man from all other animals but also has resulted in a highly organized society. Active participation in that society requires communication skills (Liben, 1978). For those with significant deficits in communication, such as autism, learning can be a very slow and unproductive undertaking. For such persons, success as an adult (i.e. gainful employment and independent living) is severely hampered.

Autistic persons are generally considered to possess the physical and intellectual capabilities required for acquisition of some basic educational and vocational skills. Wing (1976) reports that while the majority of autistic children do not have normal intelligence, their intellectual functioning is not severely limited. Most possess the capabilities necessary for some education and training. Furthermore, Ritvo (1976) notes that autistic children have near normal physical functioning; some soft neurological deficits are apparent, but in general the population is physically able. The lack of language and communication skills, however, seriously impedes productive use of these physical and intellectual capabilities (Wing, 1976).

Stubbins (1977) aptly notes that America is built on the work ethic and that those who cannot participate are rejected. Moreover, society creates barriers which prevent the severely handicapped from participating. Dependence on communication in the work environment is one such barrier. Hence, an effective method for development of communication skills in autistic persons would not only improve the quality of their lives but also might improve their integration and participation into the mainstream of society. Intensive training with oral language has not provided many autistic individuals with dynamic functional communication skills (Carr et al., 1978). Thus, researchers and educators are occupied with the investigation of alternative methods of communication, principally manual communication in conjunction with oral language. Because communication is an issue of vital import in the habilitation of autistic children, development of the most efficient and effective training methods possible is a goal of educators and researchers.

Evolution of effective training methods must develop from from our understanding of the autistic child's response to manual sign signals, speech signals, and a combination of the two. Presently, we know the autistic child's response to a combination of the two signals; research on manual signing and autism has indicated that autistic children can learn to understand and produce a limited number of manual signs when trained using a combination of speech and manual signs. To develop efficient and effective training techniques, knowledge of which stimuli facilitate comprehension as well as expression is needed. The present study, which was designed to investigate this question, has resulted in information which may be used toward the development of more effective teaching methods.

Implications

This project demonstrates that autistic children are able to learn when simultaneous communication is used as a teaching technique. Throughout this study each of the subjects rapidly learned the task before them and maintained a consistently high level of performance on tasks in which simultaneous communication was used as the stimulus.

Although each of the subjects responded with a high degree of accuracy to simultaneous communication stimuli, it became apparent that each of the three subjects was attending to different aspects of the stimuli presented in simultaneous communication. When taught using simultaneous communication, one subject attended only to the manual signs presented, one attended only to the verbalizations presented, and the other attended to both the manual signs and the verbalizations. When forced to select one of the components of simultaneous communication over the other, the subject who previously had attended to both of the components did not alternately select between the two; he consistently preferred the verbal component over the manual sign component.

These findings of distinct differences in a subject's responses to the components of simultaneous communication and marked differences among the three subjects are in agreement with the results reported in the literature on stimulus overselectivity in autistic children. The results of research in this area indicate that autistic children have a tendency toward attending to only one of numerous stimuli available and that while the preferred stimulus is consistent for a given subject, it varies among subjects (Kolko et al., 1980; Lovaas et al., 1971). Clearly, this characteristic pattern of responding makes generalization of specific findings from one autistic child to others difficult; however, the finding that patterns of responses to the components of simultaneous communication are specific to the individual is generalizable across subjects.

Kolko et al. (1980) reported that during training with multisensory input the preferred stimulus not only was selected consistently but also attended to exclusively, thus reducing or eliminating the impact of the remaining stimuli. This finding of Kolko et al. (1980) is supported by the results of the present study. The combination of the two sensory modalities, the manual signs and the verbalizations, did not appear to be any more or less effective as a training technique than either manual signs alone or speech alone for a given autistic child. The addition of manual signs to the verbal stimuli for the two subjects who attended to the verbal input did not enhance or impair their learning compared to training which used only their preferred stimulus modality (verbalizations). Further, the addition of verbalizations to the manual signs for the one subject who attended only to the manual signs did not affect his learning positively or negatively. During training, the subjects attended only to their preferred modality.

Learning was impaired if teaching utilized only the non-preferred sensory mode. The child who responded only to manual signs became physically violent and attacked the investigator when only verbalizations were used as a teaching technique. He did not learn the required task through this mode. The subject who responded only to the verbal component of simultaneous communication became very agitated and tearful when only manual signs were used for teaching. His performance was no better than that expected by guessing. The subject who attended to both components of simultaneous communication but preferred the verbal component was not able to achieve with as much accuracy when only manual signs were used for teaching compared to teaching which used only verbal input.

Numerous researchers have studied the ability of autistic children for learning through training with simultaneous communication and have reported that such multisensory input is successful (Alarcon, 1977; Barrera et al., 1980; Brady & Smouse, 1978; Benaroya et al., 1977; Konstantareas et al., 1979; Miller & Miller, 1973). Furthermore, Barrera et al. (1980) and Brady & Smouse (1978) contend that training with simultaneous communication is superior to other training methods.

Clearly, the findings of the present study indicate that simultaneous communication does not enhance learning in autistic children; it is no more effective than either of the components separately. The advantage to simultaneous communication lies in the fact that it contains several modes of input which allow children taught in a group to select their preferred input mode. While simultaneous communication may not be most effective for a given child, it may be preferred for an entire class since different children learn through different input modalities.

These findings do not support the rationale that manual signs should be used with autistic children due to a preference for visual stimuli over auditory stimuli (Casey, 1978; Fulwiler & Fouts, 1976). Two of the subjects chose the auditory stimuli over the manual signs. Further, the results do not support the suggestion that multisensory input training is better for autistic children than single sensory input (Barrera et al., 1980; Benaroya et al., 1977; Brady & Smouse, 1978). The combination of manual signs and speech did not enhance learning.

Simultaneous communication appeared to be the most effective technique for training autistic children when the data were grouped across subjects for analysis. This type of analysis for the comparision of the effectiveness of simultaneous communication versus teaching using verbal input or manual signs only is misleading. Each subject responded differently to training with manual signs only and training with speech only, however, all of the subjects responded identically with training which used simultaneous communication. Their identical responses reflected their ability to achieve when presented with their preferred stimulus. Teaching which used only one of the components and denied input from the preferred stimulus decreased the apparent effectiveness of that particular component. Therefore, the superiority of simultaneous communication when the data is grouped is simply a reflection of the ability of the subjects when presented with their preferred stimulus modality separately.

Conclusions

The following conclusions can be drawn based upon the results of this study:

1. Autistic children appear to learn when taught using simultaneous communication.
2. Autistic children each appear to respond differently to simultaneous communication stimuli.
3. Autistic children appear to select and attend to only one of the components of simultaneous communication (either the speech or the manual signs).
4. Simultaneous communication may not facilitate or inhibit comprehension in autistic children compared to the effect of the selected component of simultaneous communication.
5. Simultaneous communication may not be more or less effective for facilitation of comprehension in

autistic children than either of the components separately.

6. Comprehension learning in autistic children appears impaired if teaching does not include the child's preferred input modality.

Recommendations

The results of this study suggest that thorough educational assessments of autistic children should include a procedure for determining the input modality that is most effective and least effective for facilitation of communication and learning.

The methodology utilized in this study demonstrated that systematic manipulation of identified stimulus components of simultaneous communication was an effective procedure; the preferred stimulus component was identifed easily for each subject and the role of the components during a learning task became evident.

To evaluate a child's response to simultaneous communication and determine which component stimulus inhibits learning and which stimulus is the preferred input modality, the methodology used in this study may be useful. The following five steps can be implemented to achieve this goal:

1. Assemble a kit of nine nonsense objects with corresponding nonsense manual signs and labels.

2. Assemble three objects on the table and teach the child to point to the one labeled. Label the objects using simultaneous communication.
3. After the child has learned the task, randomly label the objects using only the verbal label (ten presentations) and only the manual sign label (ten presentations) and record responses.
4. Present three new objects and teach the child, using only the verbal label, to point to the labeled object. If the child cannot learn the task add the manual sign label. Record the responses.
5. Repeat step four teaching with only the manual sign label.

The above procedure will result in information about the stimuli in simultaneous communication which inhibit comprehension and facilitate comprehension. The methodology offers the educational and therapeutic diagnostician an additional tool useful in gathering data for decision-making for autistic children.

Suggestions for Further Research

The present study was concerned with the impact of simultaneous communication on comprehension. Further research is indicated to determine whether the findings generalize to development of expressive language.

Furthermore, additional research is needed to substantiate the finding that the combination of stimuli in simultaneous communication does not inhibit or enhance comprehension. Perhaps the task in this study was not sensitive enough to detect an impact of the combination of the stimuli. Confirmation of this result appears important because of the associated implications for educational planning.

Summary

The results of this study indicate that autistic children have a tendency toward selection of one of the component stimuli of simultaneous communication. The selected component was consistent for a given child; learning was inhibited if teaching did not include input from the selected modality. Suggestions for use of the methodology employed in this study for educational decision-making was included as well as suggestions for further research on the topic.

APPENDIX A
DESCRIPTIONS OF SUBJECTS AND BEHAVIORAL OBSERVATIONS

Subject A

Age: 14.2 years
Sex: Male

Educational background

- private evaluation when 5 years old; recommended inpatient placement; family declined
- placed in a special education center when 6 years old
- diagnosed as autistic when 8 years 9 months; placed in classes for autistic children

Birth history

- mother reports as normal

Early developmental history

- growth rate: normal to 3 years of age
- first walked: 9-12 months
- first talked: 9-12 months
- social interactions: withdrawn
- first noticed difficulty: at 3 years of age when speech deteriorated, tantrums began, rocking behavior increased, withdrawn behavior worsened

Reported behavioral problems

- rocks frequently
- withdrawn
- squeals
- no communicative language
- bites, slaps, grabs, pinches
- flaps materials
- sudden jumping
- physically violent when confused or frustrated
- shows few signs of enjoyment
- little interest in exploring environment

Work characteristics

- motivated to complete tasks
- generally cooperative
- works fast
- knows when he is correct; not willing to guess when unsure, wants adult assistance to get right answer

- can work independently
- maintains on-task behavior well

Test information

Merrill-Palmer - 40 (at 9 yrs.)
Vineland - 2.6 (at 9 yrs.)
PPVT - M.A. = 2.4 (simultaneous communication used)
CARS - 47 1/2 = severely autistic

1. Relationship with people - moderately abnormal relatedness
   - at times unaware of others
   - initiates minimal contact
   - empty impersonal quality to contacts

2. Verbal and motoric imitation - moderately abnormal
   - imitates only sometimes
   - requires great encouragement to imitate
   - extremely difficult to elicit vocal imitation

3. Affect - moderately to severely abnormal
   - reactions are very inhibited, often excessive
   - exhibits grimacing
   - some inappropriate responses to situations
   - perseverates on rocking and slapping

4. Body awareness - severely abnormal use of body
   - much rocking
   - considerable self-directed aggression
   - wipes face very often
   - bursts of jumping

5. Relation to non-human objects - moderately inappropriate interest, use, and exploration of objects
   - lacks interest in objects generally
   - peculiar use of objects; flutters book pages
   - picks at objects with fingernails sometimes

6. Adaptation to change - severe resistance
   - *may* tantrum if required to do new task

7. Visual responsiveness - moderately abnormal
   - looks "through" people
   - stares in space, at times
   - may hold materials very close to eyes

8. Auditory responsiveness - moderately to severely abnormal responses
   - shows hypersensitivity; covers ears frequently
   - little attention to auditory stimuli

9. Near receptive responsiveness - mildly to moderately abnormal responses
   - lacks appropriate response to pain
   - self-injurious behavior

10. Anxiety reaction - moderately to severe anxiety reactions
    - laughs, jumps, shows fearfulness, rocks, resists intermittently throughout a new activity

11. Verbal communication - severely abnormal
    - absence of intelligible words

12. Nonverbal communication - mildly to moderately abnormal
    - simple vague pointing on a very limited scale

13. Activity level - mildly abnormal
    - mildly restless, no interference with activity; easily controlled

14. Intellectual functioning - moderately abnormal
    - very scattered skills

15. General impressions - moderate to extreme signs of autism

Preschool Language Scale - language age = 2.2

1. Auditory comprehension - 2.3
   - recognizes basic body parts
   - follows directions
   - points to simple pictures
   - understands concept of 'one'
   - difficulty understanding function of objects, action words, and prepositions

2. Verbal ability (manual signs) - 2.1
   - identifies several basic pictures
   - asks for simple need
   - may imitate signs
   - uses no combinations or pronouns
   - does not refer to self by name

Callier-Azusa

1. Motor development
   a. postural control
      - somewhat uncoordinated in jumping
   b. locomotion - 4 years
      - runs; not smoothly
      - difficulty skipping and hopping

- c. fine motor - 2 years (some skills up to 6 years)
    - strings beads
    - holds pencil correctly
    - difficulty turning a lid
    - cuts with scissors
    - difficulty tying
- d. visual motor - 3 years (some skills up to 7 years)
    - copies a cross
    - difficulty catching with arms flexed
    - bounces a ball
    - cuts out a circle

2. Perceptual development
    - a. vision - normal
    - b. auditory - normal
    - c. tactile - <1 year (with many scattered skills up to age level)
        - does not explore objects tactilely
        - does not recognize objects by touch
        - points to part of body touched

3. Daily living skills
    - a. dressing - 2 years (skills up to 5 years)
        - dresses with little assistance
        - does not distinguish front from back
        - zips
    - b. personal hygiene - 2 years (scattered skills up to 6 years)
        - washes and dries hands
        - brushes hair with assistance
    - c. feeding - 4 years
        - pours from container
        - uses napkin
        - uses fork
        - does not use knife
    - d. toileting - normal

4. Cognition and communication
    - a. cognition - <1 year (very scattered skills up to 6 years)
        - recognizes object if sees part
        - associates objects with use
        - does not manipulate objects
        - no curiosity about objects
        - recognizes size differences
        - recognizes action in pictures
    - b. receptive language - 1 year
        - understands a few single commands
        - responds to inhibitory words
        - responds to name (sign)
        - does not understand wh- questions

- c. expressive language - 1 year (some skills at 1 1/2 years)
    - imitates several gestures after prompting
    - has several spontaneous gestures (3)
    - does not label objects
- d. speech - <1 year
    - makes some sounds but not 'speech-like'

5. Social development
    - a. adults - <1 year (some skill at 1 1/2 year level)
        - recognizes familiar adults
        - does not initiate contact
        - responds to simple commands
        - uses adult as a resource
    - b. peers - <1 year
        - responds to peer presence
        - does not initiate contact
    - c. environment - <1 year (some skills up to 3 years)
        - reacts to unfamilar situations
        - reacts to changes in environment
        - uses objects correctly
        - toilet trained
        - does not know not to hit others

Subject B

Age: 8.6 years
Sex: Male

Educational background
- private evaluation when 3 years old; diagnosed as a severe behavior problem
- diagnosed as autistic when 4 years old; placed in classes for autistic children

Birth history
- mother reports as normal

Early developmental history
- growth rate: normal
- first walked: 9-12 mos
- first talked: mother unsure; reports as very delayed
- social interactions: withdrawn
- first noticed difficulty: at 1 1/2 years of age when language had not developed; child very content to stare out of windows; pronounced withdrawal

Reported behavioral problems
- explosive tantrums; bites; hits; cries; runs away
- refusal behavior
- inappropriate smiling
- staring at objects or celing when unoccupied
- low tolerance for frustration

Work characteristics
- attends to tasks and directions; good eye contact
- curious about environment
- anxious to complete tasks
- enjoys activities
- understands reward and punishment
- difficulty working independently
- can be cooperative

Test information

Merrill-Palmer - 50 (at 6 years)
Vineland - 3.3 (at 6 years)
PPVT - M.S. = 2.7
CARS - 37 1/2 moderately autistic

1. Relationship with people - mildly to moderately abnormal relatedness
   - negativism
   - some avoidance

2. Imitation (verbal and motoric) - mildly abnormal
    - hesitant to imitate verbal stimuli
    - resists some attempts for imitation
3. Affect - moderately abnormal affect
    - may smile inappropriately when unoccupied
    - explosive behavior when doesn't get own way
4. Body awareness - mildly abnormal use of body
    - twirls
    - watch hands move in space
5. Relation to nonhuman objects - mildly inappropriate use of objects
    - may hold objects in space for extended periods of time
6. Adaptation to change - mild to moderate resistance to change
    - persists in an activity
    - becomes frustrated if redirected; may tantrum
    - sometimes severe reactions; sometimes normal reactions
7. Visual responsiveness - mildly to moderately abnormal visual responses
    - stares in space
    - may look "through" people
    - looks at materials from unusual angles
8. Auditory responsiveness - mildly abnormal auditory responses
    - some lack of response to auditory stimuli
    - may need to repeat instructions
9. Near receptor responsiveness - mildly abnormal
    - slightly abnormal exploration of objects
10. Anxiety reaction - moderate anxiety reactions
    - withdrawal outside classroom
    - aggressive tantrums if fearful of punishment
    - mild fearfulness
11. Verbal communication - speech is severely abnormal
    - generally unintelligible grunts
12. Nonverbal communication - mildly abnormal
    - some manual signs
    - much pointing and gesturing

13. Activity level - mildly abnormal
    - may wander in room
    - easily controlled

14. Intellectual functioning - moderately abnormal
    - some skills delayed
    - some skills near age level

15. General impressions - moderate signs of autism

Preschool Language Scale - language age = 4.0

1. Auditory comprehension = 4.11
    - compares size
    - match set
    - group objects
    - recognize time, colors
    - distinguishes prepositions
    - difficulty comprehending texture names
    - understands use of objects
    - difficulty with application of right/left orientation instruction
    - understands basic number concepts
    - knows body parts

2. Verbal ability - 3.0
    - names basic pictures
    - no pronouns
    - no intelligible word combinations
    - poor sound production
    - knows full name
    - counts
    - repeats four digits

Callier-Azusa Scale

1. Motor development
    a. postural control - normal
    b. locomotion - 4 years
        - runs well
        - difficulty skipping; hopping forward on one foot
        - kicks ball; runs to catch ball
    c. fine motor - 2 years (few scattered skills up to 6 years)
        - strings beads
        - screws on lids
        - holds pencil correctly
        - cuts with scissors
        - uses hands separately
        - difficulty tying

   - d. visual-motor - 4 years (with scattered skills up to 7 years)
     - copies cross
     - draws straight line between two dots
     - colors in lines
     - cuts on circle

2. Perceptual development
   - a. vision - normal
   - b. auditory - normal
   - c. tactile - 4 years (with skills up to 7 years)
     - tactilely matches textures and objects by shape
     - points to part of body touched

3. Daily living skills
   - a. dressing - 4 years
     - unbuttons
     - puts on coat
     - dress with assistance
     - buttons
   - b. personal hygiene - 4 years
     - bathes with supervision
     - brushes hair with assistance
     - washes and dries hands
   - c. feeding - 5 years
     - uses knife to spread
     - eats sandwiches without loss
     - does not use fork in conjunction with knife
   - d. toileting - normal

4. Cognition and communication
   - a. cognition - 1 1/2 years (very scattered skills up to 5 years)
     - knows object function
     - imitates; gestures
     - associates picture with an activity
     - relates events
     - understands numerals 1-4
   - b. receptive language - 1 1/2 years (very scattered skills up to 3 years)
     - understands 2-stage related command
     - responds to 'who'
     - remembers events of yesterday
   - c. expressive language - 1 1/2 years (skills up to 2 years)
     - has sign vocabulary or word vocabulary greater than 50 words
     - expresses 'no'
     - uses own name
     - lacks grammatical structure

- d. speech - 1 year
  - less than 10 spoken words are comprehensible
  - imitates sounds
  - uses sound to communicate

5. Social development
   - a. adults - 1 year (with many skills up to 2 years)
     - attempts to maintain contact
     - responds to commands
     - concept of 'mine'
   - b. peers - <1 year
     - responds to presence
     - shows interest in object peer holds
     - does not attempt to initiate contact
   - c. environment - <1 year (with skills up to 3 years)
     - differentiates familiar from unfamiliar
     - reacts to new situations
     - does not anticipate events
     - understands social rules

Subject C

Age: 7.10
Sex: Male

Educational background
- private evaluation when 3 years old; enrolled in a program for behavior management and tantrums
- enrolled in classes for autistic children when 5 years old; diagnosed as autistic

Birth history
- mother reports as normal

Early developmental history
- growth rate: normal
- first walked: 9-12 months
- first talked: 4-5 years
- social interactions: preferred solitary play
- first noticed difficulty: at 2 years of age when no speech had developed

Reported behavioral problems
- tantrums
- some fearfulness
- extreme focus and distress with body parts
- impulsiveness and perseveration
- jargon and echolalia
- sudden jumping
- bites own hand
- inappropriate giggling

Work characteristics
- responds to directions
- cooperative
- maintains on-task behavior well
- can work independently
- compeltes tasks
- understands reward and punishment

Test information
Merrill-Palmer - 69
Vineland - 5.5
PPVT - 4.5
CARS - 32 1/2 - mildly autistic

1. Relationships with people - mildly to moderately abnormal relatedness
    - lacks eye contact
    - some aloofness

2. Imitation (verbal and motoric) - mildly abnormal
    - resists motor imitations

3. Affect - moderately abnormal affect
    - some bland responses to stimuli
    - episodes of fearful reactions

4. Body awareness - moderately abnormal use of body
    - poor coordination
    - looks at hand and bites it
    - grabs at genitals

5. Relation to nonhuman objects - slightly abnormal interest in and use of objects
    - mild disinterest in objects

6. Adaptation to change - slightly abnormal
    - insists on completing a task
    - will jump from chair to complete an activity that was previously interrupted

7. Visual responsiveness - mildly to moderately abnormal visual responses
    - looks at items very closely
    - preoccupation with projectors
    - looks "through" people
    - some staring in space

8. Auditory responsiveness - slightly abnormal
    - generally normal with some lack of response to auditory stimuli
    - may need to repeat instructions

9. Near receptor responsiveness - mildly abnormal
    - bites self without pain
    - occasional fleeting sniffing of objects

10. Anxiety reaction - mild anxious reactions
    - some withdrawal
    - some crying or whining if anxious
    - some giggling

11. Verbal communication - speech is moderately abnormal
    - speaks in short sentences
    - much echolalia and jargon

12. Nonverbal communication - slightly abnormal
    - very limited non-verbal communication

13. Activity level - mildly abnormal
    - mildly restless; aimless wandering about room
    - very controllable

14. Intellectural functioning - mildly to moderately abnormal
    - depressed skills, some closer to age level than others

15. General impressions - mild to moderate signs of autism

Preschool Language Scale - language age = 4.0

1. Auditory comprehension = 4.5
   - recognizes time, colors
   - matches sets
   - groups objects
   - compares size
   - differentiates texture
   - understands use of objects
   - understands basic number concepts
   - difficulty with body parts' names

2. Verbal ability - 3.6
   - gives full name
   - uses plurals
   - does not converse in sentences
   - counts
   - pronounces basic phonemes correctly
   - difficulty with opposites

Callier-Azusa Scale

1. Motor development
   a. postural control - normal
   b. locomotion - 4 years
      - skips; hops
      - difficulty with smooth running and running to catch a ball
   c. fine motor - 4 years
      - cuts with scissors
      - uses hands separately
      - difficulty tying a bow
   d. visual motor - 3 years (with higher skills to 7 years)
      - difficulty catching a ball with arms flexed
      - copies a cross, square, diagonal, triangle
      - cuts out a circle

2. Perceptual development
   a. vision - normal
   b. auditory - normal
   c. tactile - 4 years (with scattered skills up to 7 years)
      - difficulty matching by size tactilely
      - can point to part of body touched

3. Daily living skills
   a. dressing - 4 years
      - dresses with exception of buttoning and tying
   b. personal hygiene - 4 years
      - bathes with supervision
      - brushes hair with assistance
      - washes and dries hands independently
   c. feeding - 5 years
      - uses a knife
      - eats sandwiches well
      - uses fork to cut
      - cannot prepare simple food
   d. toileting - normal

4. Cognition and communication
   a. cognition - 1 year (very scattered skills at a higher level up to 6 years)
      - does not show curiosity
      - does not use gestures or imitate well
      - recognizes size differences
      - groups objects
      - understands numbers 1 - 10
   b. receptive language - 2 years
      - follows two-stage commands
      - understands "what" and "where"
      - does not understand 'why' or 'when' or 'who'
   c. expressive language - 1 year (very scattered skills at a higher level up to 3 years)
      - has connected speech for communication
      - initiates a routine
      - does not show interest in learning language
      - does not use "ing"
      - uses "in" and "on"
   d. speech - 2 years
      - has 50 comprehensible words but less than 400

5. Social development
   a. adults - 1 year (scattered skills up to 2 years)
      - may initiate contact
      - does not maintain contact
      - responds to commands
      - makes choices
      - does not engage in pretend play

b. peers - <1 year
   - responds to peer's presence
   - no initiation of contact or interest

c. environment - <1 years (some skills as high as three years)
   - differentiates familiar from unfamiliar
   - responds to changes
   - does not anticipate events
   - toilet trained
   - has social rules
   - understands taking turns

Behavioral Observations

On-task behavior

1. Method

   Observer used a stop watch and every 15 seconds rated the child's behavior according to the following guidelines:

   On-task
   - on-task appropriate - child is engaged in assigned task, using materials appropriately and displaying appropriate behaviors
   - on-task inappropriate - child is engaged in assigned task and using materials appropriately but displays stereotypic behaviors

   Off-task
   - negativism - child refuses to engage in desired activity
   - other activity - child is appropriately engaged in an activity other than the desired task
   - inappropriate use of materials - child is engaged in desired activity but is manipulating the materials in an unconvential manner
   - inappropriate behavior - child is displaying bizarre or stereotyped behavior and not attending to desired task

2. Results - Group Setting

	Subject A	Subject B	Subject C
On-task			
On-task appropriate	43%	59%	60%
On-task inappropriate	9%		16%
Total	52%	59%	76%
Off-task			
Negativism		38%	
Other activity			
Inappropriate use of materials			
Inappropriate behavior	48%	3%	24%
Total	48%	41%	24%
Total	100%	100%	100%

3. Results - Individual Work Setting

	Subject A	Subject B	Subject C
On-task			
On-task appropriate	64%	77%	83%
On-task inappropriate	36%		3%
Total	100%	77%	86%
Off-task			
Negativism		7%	3%
Other activity		3%	
Inappropriate use of materials		5%	
Inappropriate behavior		8%	11%
Total	0%	23%	14%
Total	100%	100%	100%

4. Results - Independent Work Setting

	Subject A	Subject C	Subject C
On-task			
On-task appropriate	65%	21%	54%
On-task inappropriate	35%	12%	14%
Total	100%	33%	68%
Off-task			
Negativism		17%	
Other activity		12%	3%
Inappropriate use of materials		33%	
Inappropriate behavior		5%	29%
Total	0%	67%	32%
Total	100%	100%	100%

Characteristic behaviors

1. Method

Observer recorded atypical and inappropriate responses and behaviors of children during two 15-minute individual work sessions using a stop-watch.

2. Results:

	Frequency (per minute)	Intensity	Duration
Subject A			
Behavior			
Slap aide	1.0	hard	$\bar{X}$ = 2 sec.
Wipe face on shirt	.7		$\bar{X}$ = 2 sec.
Laugh	.1	normal	$\bar{X}$ = 2 sec.
Slap own back	.2	hard	$\bar{X}$ = 2 sec.
Sounds	.7	normal	$\bar{X}$ = 3 sec.
Flap hands	.2	mild	$\bar{X}$ = 2 sec.
Jump up	.1	mild	$\bar{X}$ = 2 sec.
Rock		moderate	Constant
Slap chest	.1	hard	$\bar{X}$ = 1 sec.
Clap	.1	loud	$\bar{X}$ = 1 sec.
Shake head	.7	mild	$\bar{X}$ = 2 sec.
Subject B			
Behavior			
Foot on chair	.3		$\bar{X}$ = 3 sec.
Stare at floor and ceiling	.5		$\bar{X}$ = 35 sec.
Screaming	.2	loud	$\bar{X}$ = 5 sec.
Whining	.2	moderate	$\bar{X}$ = 4 sec.
Hit wall	.1	hard	$\bar{X}$ = 6 sec.
Ignore aide	.2		$\bar{X}$ = 32 sec.
Sounds	.3	normal	$\bar{X}$ = 3 sec.
Refuse to answer	.2		$\bar{X}$ = 42 sec.
Out of seat	.4	runs away	$\bar{X}$ = 24 sec.
Biting	.1	hard	$\bar{X}$ = 7 sec.
Doodling	.2		$\bar{X}$ = 26 sec.
Sharpen pencil	.1		$\bar{X}$ = 32 sec.
Subject C			
Behavior			
Talk to self	13	normal	$\bar{X}$ = 4 sec.
Sounds to self	14	normal	$\bar{X}$ = 2 sec.
Scribbling	1	hard	$\bar{X}$ = 2 sec.
Echolalia	19	normal	$\bar{X}$ = 3 sec.
Head down	2		$\bar{X}$ = 10 sec.
Out of seat	2		$\bar{X}$ = 8 sec.
Wandering	1		$\bar{X}$ = 11 sec.
Wriggle hands	2	mild	$\bar{X}$ = 3 sec.
Touching board	4	mild	$\bar{X}$ = 2 sec.
Staring	2		$\bar{X}$ = 6 sec.

Communication behavior

The observer categorized the communicative behavior of each child during two 15-minute individual sessions timed by a stop-watch.

	Frequency (per minute)
Subject A	
Spontaneous signs	0
Imitative signs	4.8
Responsive signs	0
Speech	0
Subject B	
Spontaneous signs	.2
Imitative sign	.2
Responsive sign	.1
Spontaneous simultaneous communication	.8
Imitative simultaneous communication	.4
Responsive simultaneous communication	.5
Spontaneous speech	1.7
Imitative speech	.3
Responsive speech	.4
Subject C	
Signs	0
Spontaneous speech	2.3
Imitative speech	0
Responsive speech	2.1
Echolalia	1.2
Jargon	1.1

APPENDIX B
STIMULUS MATERIAL

Nonsense Words

Object	Name
Object #1	gaʊg
Object #2	vɝθ
Object #3	waɪʒ
Object #4	dɝl
Object #5	loʒ
Object #6	pʌtʃ
Object #7	tɪs
Object #8	mɜb
Object #9	zɑɚ
Object #10	dzæt
Object #11	tʃin
Object #12	saʊt
Object #13	zaɪf
Object #14	bæp
Object #15	ɚʌt
Object #16	fidʒ
Object #17	haʊf
Object #18	soθ
Object #19	ʃɔg
Object #20	fob
Object #21	kɔɪdʒ

Nonsense Manual Signs*

Object	Sign Description
# 1	'i' in front of mouth; palm facing left; hand rotates at wrist so little finger points left
# 2	fingers of both hands together facing chest; knuckles touch; hands move apart
# 3	right back of hand touches left back of hand; right moves counterclockwise
# 4	right 'u' scratches toward body on back of left hand
# 5	right hand palm facing out held by ear; palm turns to ear; then out
# 6	two hands at chest; palms face body; fingers interlock; right moves forward
# 7	right back of hand knocks under left arm
# 8	2 'o's; thumbs touch; 'o's open; palms touch
# 9	'u' on right hand points to right eye; turn to face out
#10	right finger and thumb touch left finger and thumb; right turns a 45° angle toward body
#11	right back of hand rests on left arm; fingers bend upward
#12	index finger points out; thumb points up; the thumb touches nose then index finger touches nose
#13	right index finger on top of left arm; then circles arm
#14	two hands palms down; right over left; left moves over right; palm turns up
#15	right fist rubs under left fist towards chest
#16	right 'u' points left; thumb pointing up with palm touching chest; thumb bends to touch index finger

#17 right 'u' with palm facing right is made by left cheek; palm turns to left

#18 right palm open facing nose; moves right and forms 's' with palm facing rear

#19 two fists with knuckles touching; left slides down; palm opens

#20 right hand palm down in front of chin; hand drops down and palm closes

#21 left fist with palm up and little finger extended; right little finger touches left little finger at tip and moves toward palm; left little finger curls around right little finger

---

*Descriptions are for a right-handed signer.

Identified Attributes of Nonsense Signs

Randomly distributed characteristics

Sign for Object #	Number of Movements	Number of Hands	Place
# 1	1	1	Head
# 2	1	2	Chest
# 3	1	2	Chest
# 4	1	2	Chest
# 5	2	1	Head
# 6	1	2	Chest
# 7	1	1	Chest
# 8	2	2	Chest
# 9	1	1	Head
#10	1	2	Chest
#11	1	1	Chest
#12	1	1	Head
#13	1	1	Chest
#14	2	2	Chest
#15	1	2	Chest
#16	1	1	Chest
#17	1	1	Head
#18	2	1	Head
#19	2	2	Chest
#20	1	2	Head
#21	2	2	Chest

Nonsense Objects

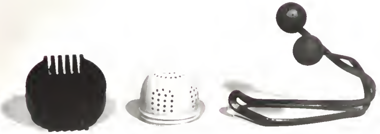


Figure 17. Object #1, #2, and #3.

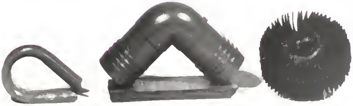


Figure 18. Object #4, #5, and #6.

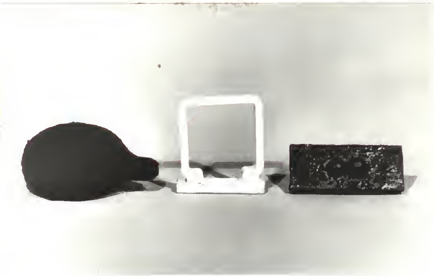


Figure 19. Object #7, #8, and #9.

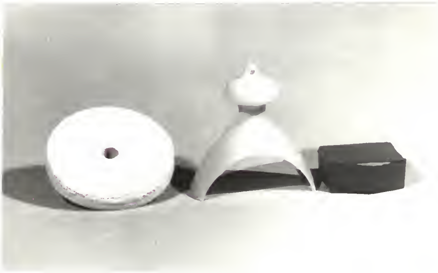


Figure 20. Object #10, #11, and #12.

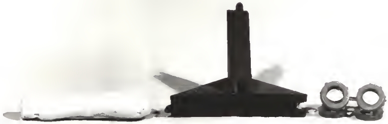


Figure 21. Object #13, #14, and #15.

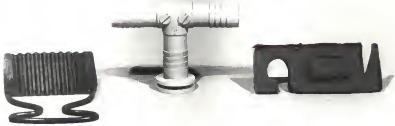


Figure 22. Object #16, #17, and #18.

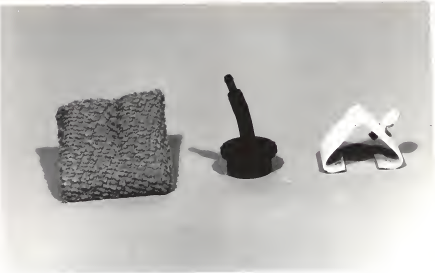


Figure 23. Object #19, #20, and #21.

Identified Attributes of Nonsense Objects

Characteristics held constant:
relative size
no moving parts

Randomly distributed characteristics:

Object #	Top Surface	General Shape from Top View	Color	Texture	Composition	Density	Number of major Distinguish Component Shapes
# 1	Flat	Round	Green	Rough	Plastic	Closed	1
# 2	Curved	Round	Yellow	Smooth	Metal	Closed	1
# 3	Angular	Triagle	Blue	Smooth	Metal	Open	2
# 4	Flat	Triangle	Red	Smooth	Metal	Open	1
# 5	Curved	Cylindrical	Blue	Rough	Plastic	Open	1
# 6	Flat	Round	Green	Rough	Paper	Closed	1
# 7	Flat	Round	Green	Rough	Fabric	Closed	1
# 8	Angular	Rectancular	White	Smooth	Plastic	Open	2
# 9	Curved	Rectangular	Blue	Rough	Wood	Closed	2
#10	Flat	Round	White	Smooth	Fabric	Closed	1
#11	Curved	Rectangular	Yellow	Smooth	Plastic	Open	2
#12	Flat	Square	Red	Smooth	Paper	Closed	2

#13	Curved	Cylindrical	White	Smooth	Fabric	Closed	1
#14	Angular	Triangle	Blue	Smooth	Wood	Closed	2
#15	Curved	Cylindrical	Red	Smooth	Plastic	Open	1
#16	Angular	Rectangle	Blue	Rough	Metal	Open	1
#17	Curved	Cylindrical	Yellow	Rough	Plastic	Closed	1
#18	Flat	Rectangle	Red	Smooth	Fabric	Closed	2
#19	Flat	Square	Yellow	Rough	Fabric	Closed	1
#20	Curved	Cylindrical	Green	Smooth	Plastic	Closed	2
#21	Angular	Triangle	White	Smooth	Metal	Open	2

APPENDIX C
OBSERVATIONAL RECORD

Subject: ________
Phase: ________
Probe: ________

Trial	Objects Arranged	Facial Expression Change	Postural Change	Prolonged Visual Contact With Object	Subject Responded
1					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

APPENDIX D
RAW DATA

	Subject A			Subject B			Subject C		
				Section I*					
Baseline Probes (A) (n=15)	A_1	A_2	A_3	A_1	A_2	A_3	A_1	A_2	A_3
	15	15	15	14	15	15	15	15	15
	15	15	15	14	15	15	15	15	15
	15	15	15	15	15	15	15	15	15
Treatment 1 Probes (B_{T1})	$B_{T1.1}$	$B_{T1.2}$		$B_{T1.1}$	$B_{T1.2}$		$B_{T1.1}$	$B_{T1.2}$	
Simultaneous Communication (n=15)	15	15		15	15		15	15	
	15	15		15	15		15	15	
	15	15		15	15		15	15	
Manual Signs Only (n=15)	15	15		15	15		2	3	
	15	15		14	15		1	2	
	15	15		15	15		2	2	
Speech Only (n=15)	1	2		15	15		15	15	
	1	2		15	15		15	15	
	2	1		15	15		15	15	

APPENDIX D
(Continued)

	Subject A		Subject B		Subject C	
Treatment 2 Probes (B_{T2})	$B_{T2.1}$	$B_{T2.2}$	$B_{T2.1}$	$B_{T2.2}$	$B_{T2.1}$	$B_{T2.2}$
Simultaneous Communication (n=6)	6	6	6	6	6	6
	6	6	6	6	6	6
	6	6	6	6	6	6
Manual Signs (n=12)	12	12	0	0	0	0
	12	12	0	0	0	0
	12	12	0	0	0	0
Speech (n=12)	0	0	12	12	12	12
	0	0	12	12	12	12
	0	0	12	12	12	12

Section II**

Treatment 1 (T_1)	$T_{1.1}$	$T_{1.2}$	$T_{1.1}$	$T_{1.2}$	$T_{1.1}$	$T_{1.2}$
Simultaneous Communication (n=10)	10	10	10	10	10	10
	10	10	10	10	10	10
	10	10	10	10	10	10

APPENDIX D
(Continued)

	Subject A		Subject B		Subject C	
Treatment 2 (T_2)	$T_{2.1}$	$T_{2.2}$	$T_{2.1}$	$T_{2.2}$	$T_{2.1}$	$T_{2.2}$
Manual Signs Only (n=10)	10	10	6	4	2	2
	10	10	5	6	5	4
	10	10	3	4	3	3
	--	--	6	5	3	2
	--	--	5	5	2	--
	--	--	5	--	--	--
Treatment 3 (T_3)	$T_{3.1}$	$T_{3.2}$	$T_{3.1}$	$T_{3.2}$	$T_{3.1}$	$T_{3.2}$
Speech Only (n=10)	0	0	9	9	10	10
	0	0	10	9	10	10
	0	0	10	10	10	10

APPENDIX D
(Continued)

Supplementary Treatment (T_s)	Subject A T_{s1}	Subject A T_{s2}	Subject B T_{s1}	Subject B T_{s2}	Subject C T_{s1}	Subject C T_{s2}
After Speech	10	10				
Only (T_3)	10	10				
(n=10)	10	10				
After Manual Signs			9	10	10	10
Only (T_2)			10	9	10	10
(n=10)			10	10	10	10

* Digits represent the number correct on each probe

** Digits represent the number correct in each string

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BIOGRAPHICAL SKETCH

Karen T. Poulton was born in Akron, Ohio, on September 15, 1949. She grew up in a small rural town in Ohio graduating from Norton Senior High School in 1968. She married Thomas J. Poulton, her "high school sweetheart," during their senior year at The Ohio State University and received her bachelor's degree in special education in 1972, with a major in speech and hearing therapy.

After graduation from Ohio State, Ms. Poulton worked as a speech therapist in the Columbus Public Schools and attended graduate school. She received a master's degree in speech pathology in 1975, and her Certificate of Clinical Competence in speech pathology in 1976.

In 1976, Ms. Poulton moved to Winston-Salem, North Carolina, and worked for two years at the Cerebral Palsy and Orthopedic School in Greensboro as a speech and language therapist.

In 1978, Ms. Poulton entered the doctoral program at the University of Florida to pursue interests in the coordination of educational and therapeutic programs for children with severe communication handicaps.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholary presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Robt F. Algozzine

Robert F. Algozzine, Chairman
Associate Professor of Special
Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholary presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Mary K. Dykes
Associate Professor of Special
Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholary presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Rex Schmid
Associate Professor of Special
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Ronald E. Nutter

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholary presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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Professor of Educational
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This dissertation was submitted to the Graduate Faculty of the Department of Special Education in the College of Education and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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Dean, Graduate School